



Approved Signatories:

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

Signed:

Date of issue: 17 August 2023

Certificate Number: 6405

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
Dundee City Council

Ricardo Energy & Environment ID:

ED11194/6405

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
18 Blythswood Square (2nd Floor),
Glasgow,
G2 4BG
Tel: 01235 753205

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: 17 August 2023
 Certificate Number: 6405
 Ricardo Energy & Environment ID: ED11195/6405

Dundee City Council
 NOx analysers

Station	Date of Audit	Species	Analyser Serial no	Zero Response ¹	Zero uncertainty ppb	Calibration Factor ²	Factor uncertainty %	Converter eff. (%) ³
Dundee Broughty Ferry Road	28-Jun	NOx	607	5.6	2.6	1.1750	3.50	98.0 (245nmol/mol)
		NO		2.7	2.6	1.1899	3.50	99.8 (119nmol/mol)
Dundee Lochee Road	30-Jun	NOx	727	2.1	2.6	1.1336	3.50	99.2 (254nmol/mol)
		NO		0.9	2.6	1.1412	3.50	95.4 (117nmol/mol)
Dundee Meadowside	29-Jun	NOx	20-1728	-1.0	2.5	1.0407	3.50	100 (249nmol/mol)
		NO		0.0	2.5	1.0384	3.50	100 (124nmol/mol)
Dundee Seagate	28-Jun	NOx	726	5.5	2.7	1.4344	3.50	99.2 (249nmol/mol)
		NO		0.4	2.7	1.3789	3.50	99.1 (118nmol/mol)
Dundee Whitehall Street	29-Jun	NOx	725	6.1	2.6	1.1313	3.50	96.2 (254nmol/mol)
		NO		4.7	2.6	1.1250	3.50	95.3 (117nmol/mol)

FIDAS analysers

Station	Date of audit	Analyser Serial no	Calculated ko ²	Uncertainty %	Total flow ⁴	Uncertainty %	Main flow	Uncertainty %
Dundee Broughty Ferry Road	28-Jun	11911			5.02	2.2		2.2
Dundee Lochee Road	30-Jun	8732			5.00	2.2		2.2
Dundee Mains Loan	30-Jun	8379			5.09	2.2		2.2
Dundee Meadowside	29-Jun	10883			5.02	2.2		2.2
Dundee Seagate	28-Jun	10881			5.10	2.2		2.2
Dundee Whitehall Street	29-Jun	10882			4.88	2.2		2.2





CERTIFICATE OF CALIBRATION



Date of issue: 17 August 2023
Certificate Number: 6405
Ricardo Energy & Environment ID: ED11195/6405

The gaseous ambient analysers listed above have been tested for zero response, calibration factor, linearity and converter efficiency (NO_x 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 k₀ (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 reported in concentration units of nmol/mol or µmol/mol.

¹ 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.

² The calibration factor is the multiplying factor required to scale the reading on the data logging system of the analyser into reported concentration units (nmol/mol for NO, NO_x, SO₂, O₃ and µmol/mol for CO). 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

³ Converter eff. is the measured efficiency of the NO₂ to NO converter within the oxides of nitrogen analyser under test.

⁴ 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 aux flow rate (where this is 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, 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.

⁵ The calculated k₀ value (specifically for TEOM analysers) 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 value of k₀.

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.

End of certificate