# CERTIFICATE OF CALIBRATION

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0401



Approved Signatories:

| | | | |
|---|---|---|---|
| ☐ | S. Eaton | ☐ | B Stacey |
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| ☐ | N Rand | ☑ | S Telfer |
| ☐ | B Davies | ☐ | S Gray |

Signed: STelfer

Date of issue: 06 October 2020

Certificate Number: 5139

Customer Name and Address:

Perth and Kinross Council
Pullar House
Kinnoull Street
Perth
PH1 5GD

Description: Calibration factors for the air monitoring station(s) at Perth and Kinross Council

Ricardo Energy & Environment ID: ED11194/5139

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

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Perth and Kinross 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] |
|---|---|---|---|---|---|---|---|---|
| Perth Atholl Street | 19 June 2020 | NOx | 1095 | 4.3 | 2.6 | 1.2453 | 3.51 | 98.5 |
| | | NO | | 1.5 | 2.6 | 1.2303 | 3.52 | |
| Perth Crieff | 19 June 2020 | NOx | 1337 | 3.9 | 2.6 | 1.1074 | 3.51 | 98.7 |
| | | NO | | 2.4 | 2.6 | 1.0929 | 3.52 | |

PM10 analysers

| Station | Date of audit | Analyser Serial no | Calculated ko[5] | Uncertainty % | Total flow[4] l.min-1 | Uncertainty % | Main flow l.min-1 | Uncertainty % |
|---|---|---|---|---|---|---|---|---|
| Perth Atholl Street | 19 June 2020 | 8654 | | | 4.69 | 2.2 | | 2.2 |
| Perth Crieff | 19 June 2020 | 8655 | | | 4.73 | 2.2 | | 2.2 |
| Perth Muirton | 19 June 2020 | 10603 | | | 4.46 | 2.2 | | 2.2 |

PM2.5 analysers

| Station | Date of audit | Analyser Serial no | Calculated ko[5] | Uncertainty % | Total flow[4] l.min-1 | Uncertainty % | Main flow l.min-1 | Uncertainty % |
|---|---|---|---|---|---|---|---|---|
| Perth High Street | 26 May 2020 | 26678 | 12641 | 1.0 | 16.02 | 2.2 | 2.83 | 2.2 |
| Perth High Street | 19 June 2020 | 140ab223969812 | 12641 | 1.0 | 15.98 | 2.2 | 2.88 | 2.2 |

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The gaseous ambient analysers listed above have been tested for zero response, calibration factor, linearity and converter efficiency (NOx 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.

[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 (ppb for NO, NOx, $SO_2$, $O_3$ 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:

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

[3] Converter eff. is the measured efficiency of the $NO_2$ 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 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 $k_0$ value (specifically for TEOM analysers) is the calculated $k_0$ 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 $k_0$.

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.