# CERTIFICATE OF CALIBRATION

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Signed: 

Date of Issue: 19th July 2017

Certificate Number: 3766



Customer Name and Address:

Scottish Government
Water, Air, Soils and Flooding Division
Environmental Quality Directorate
Scottish Government
Victoria Quay
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EH6 6QQ

Description: Calibration factors for Falkirk Council's Falkirk Bainsford, Falkirk Banknock, Falkirk Bo'Ness, Falkirk Grangemouth MC, Grangemouth Moray, Falkirk Haggs, Falkirk Hope Street, Falkirk Graham's Road, Falkirk West Bridge Street and Grangemouth Zetland Park monitoring station's.

| Site / Date Test Carried Out | Species | Analyser Serial No. | Zero Response[1] | Uncertainties ppb | Calibration Factor[2] | Uncertainties % | Converter eff. (%)[3] |
|---|---|---|---|---|---|---|---|
| Grangemouth Muncipal Chambers | $NO_x$ | 890617 | 0.9 | 2.5 | 0.9899 | 3.5 | 96.9 |
| | NO | 0204 | 0.1 | 2.5 | 1.0090 | 3.5 | |
| 31st January 2017 | $SO_2$ | 890414 0505 | 2.0 | 2.6 | 1.1225 | 3.2 | |
| Grangemouth Moray 31st January 2017 | $SO_2$ | 12MLC3B | 1.7 | 2.5 | 0.9697 | 3.2 | |
| Falkirk Bainsford | $NO_x$ | 809007 | 0.3 | 2.8 | 1.0007 | 3.5 | 98.4 |
| 2nd February 2017 | NO | | 0.6 | 2.8 | 1.0042 | 3.5 | |
| Falkirk Bo'Ness 31st January 2017 | $SO_2$ | 616X6GNF | 2.3 | 2.5 | 0.9911 | 3.2 | |

*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 [1] | Uncertainties ppb | Calibration Factor[2] | Uncertainties % | Converter eff. (%)[3] |
|---|---|---|---|---|---|---|---|
| Falkirk Haggs 28th February 2017 | $NO_x$ | 1401925 | 0.0 | 3.0 | 1.000 | 3.5 | 99.2 |
| | NO | | 0.0 | 2.7 | 0.9935 | 3.5 | |
| Falkirk Hope Street 28th February 2017 | $NO_x$ | 890704 0214 | 0.6 | 2.5 | 0.9717 | 3.5 | 96.0 |
| | NO | | 0.2 | 2.6 | 0.9939 | 3.5 | |
| | $SO_2$ | 890617056 | 3.5 | 2.5 | 0.9540 | 3.5 | |
| Falkirk West Bridge Street 2nd February 2017 | $NO_x$ | 1228 | 3.6 | 2.5 | 0.9304 | 3.5 | 99.3 |
| | NO | | 1.3 | 2.5 | 0.8442 | 3.5 | |
| Grangemouth Zetland Park 28th February 2017 | $SO_2$ | 4080666 00209 | 0.2 | 2.5 | 0.9015 | 3.5 | |

| Site / Date Test Carried Out | Species | Analyser Serial No. | Parameter | Specified Value | Measured Value | Deviation % | Uncertainty % |
|---|---|---|---|---|---|---|---|
| Falkirk Bainsford 2nd February 2017 | TEOM $PM_{10}$ | 27493 | Main Flow[4] | 3.300 | 3.07 | 2.5 | 2.25 |
| | | | Aux Flow[4] | 13.65 | | | |
| | | | Total Flow | 16.67 | 16.41 | -1.5 | 2.25 |
| | | | $k_0$[5] | 13101 | 12972 | -1.0 | 1.00 |
| Falkirk Grangemouth Muncipal Chambers 31st January 2017 | TEOM $PM_{10}$ | 22697 | Main Flow[4] | 2.99 | 2.92 | -2.4 | 2.25 |
| | | | Aux Flow[4] | 13.68 | | | |
| | | | Total Flow | 16.67 | 15.53 | -6.9 | 2.25 |
| | | | $k_0$[5] | 13841 | 14221 | 2.7 | 1.00 |
| Falkirk Graham's Road 2nd February 2017 | TEOM $PM_{10}$ | 22988 | Main Flow[4] | 3.00 | **3.34** | 11.4 | 2.25 |
| | | | Aux Flow[4] | 13.67 | **14.85** | 8.5 | 2.25 |
| | | | Total Flow | 16.67 | **18.19** | 9.1 | 2.25 |
| | | | $k_0$[5] | 12885 | 12923 | 0.3 | 1.00 |
| Falkirk Haggs 30th January 2017 | TEOM $PM_{10}$ | 23170 | Main Flow[4] | 3.03 | **2.96** | -2.2 | 2.25 |
| | | | Aux Flow[4] | 13.69 | **13.49** | -1.4 | 2.25 |
| | | | Total Flow | 16.67 | **16.46** | -1.3 | 2.25 |
| | | | $k_0$[5] | 13865 | 13929 | 0.5 | 1.00 |

| Site / Date Test Carried Out | Species | Analyser Serial No. | Parameter | Specified Value | Measured Value | Deviation % | Uncertainty % |
|---|---|---|---|---|---|---|---|
| Falkirk Banknock 30th January 2017 | FIDAS | 6657 | Total Flow[4] | 4.7 | 4.41 | -6.4 | 2.25 |
| Falkirk West Bridge Street 2nd February 2017 | FIDAS | 6657 | Total Flow[4] | 4.79 | 4.71 | -1.6 | 2.25 |

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

[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, $NO_x$, $SO_2$, $O_3$ 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:

**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 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.

[5]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.

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.