

Certificate of calibration

For: Dr Ruth Purvis
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Serial Number of Instrument: 1152780004

Results: **Ozone 8 nmol/mol = 1.015 NCAS Primary Standard nmol/mol – 0.135 nmol/mol**

Uncertainty at amount fractions greater than 100 nmol/mol = $\pm 3\%$ of value. Uncertainty at amount fractions between 0 and 100 nmol/mol = 3nmol/mol.

Carried out by: Dr Katie Read
NCAS Scientist
University of York
York, UK

Signed:



Authorised by: Dr Katie Read
NCAS Scientist
University of York
York, UK

Signed:



Reference to NIST Scale

The NCAS Primary Standard (TE49i) is calibrated annually at the National Physical Laboratory against the NIST Standard Reference Photometer SRP 20, quality assured and controlled by independent audit procedures. The calibration performed relates the output from the NCAS TE49i analyser front panel to the ozone amount fractions determined by the SRP.

The most recent calibration (24th September 2015) of the NCAS Primary Standard reported: -

$$\text{TE49i nmol/mol} = 1.009 \text{ SRP20 nmol/mol} - 0.1 \text{ nmol/mol}$$

Measurement procedure

The visiting instrument is calibrated in the same way. The sample line used, had previously been conditioned at an amount fraction of 1000 nmol/mol of ozone for over an hour.

Only one calibration was carried out which increases the error on the resultant data. At least two calibrations are recommended in future.

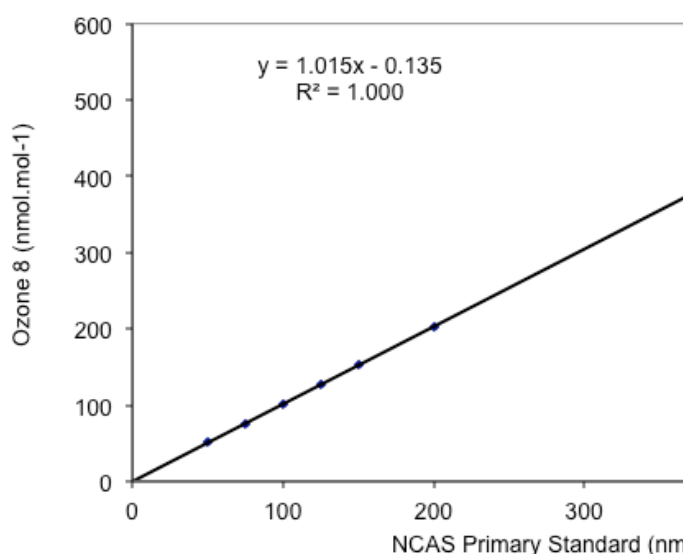
$$\text{UKMO 2B Ozone output in nmol/mol} = \mathbf{m} \text{ NCAS Primary Standard nmol/mol} + \mathbf{c}$$

where: **m** is the gradient determined as the ratio of the visiting instrument reading for ozone to the TE49i reading for ozone.

c is the zero intercept expressed in nmol/mol.

Results

NCAS Primary Standard (nmol/mol)	Ozone 8 (nmol/mol)	Standard deviation (nmol/mol)
0.00	0.00	0.08
50.02	50.67	0.09
99.99	101.35	0.10
150.02	152.02	0.07
199.98	202.70	0.14
74.98	76.17	0.18
124.99	126.83	0.16
500.01	507.72	0.75



Ozone 8 nmol/mol = 1.015 NCAS PS nmol/mol – 0.135nmol/mol

The above equation is only valid in the amount fraction range 0-200 nmol/mol.

Uncertainty is generally quoted as $\pm 3\%$ for amount fractions greater than 100 nmol/mol and 3 nmol/mol for amount fractions between 0 and 100 nmol/mol.

These uncertainties contain components arising from the uncertainty in the ozone absorption cross section, the purity of the air supply used in the calibration, any non-linearity in the analytical instrumentation, and bias in the primary standard used (based on the results of international intercomparisons).

Precision of the instrument has been calculated using the zero data and by applying the following formula:-

Precision = $\sqrt{2 \times \text{standard deviation of } 10 \times 1 \text{ minute data points}}$

The precision is 0.40 nmol/mol for this instrument.

We recommend that you carry out calibrations at least annually to verify the stability of your analyser.

This work was carried out in the COZI-Lab in the Wolfson Atmospheric Chemistry laboratories (WACL) at the University of York. The COZI-Lab is principally funded through the National Centre for Atmospheric Science (NCAS).