

## *Certificate of calibration*

For: Dr Joss Kent  
UK Met Office  
Jupiter Mezzanine  
Fitzroy Road  
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Date: 10th October 2016

Serial Number of Instrument: Model 205 Serial #1254DB

Results: **UKMO 2B Ozone nmol/mol = 0.998 NCAS Primary Standard nmol/mol – 0.097 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 (2<sup>nd</sup> September 2016) of the NCAS Primary Standard reported: -

$$\text{TE49i nmol/mol} = 1.004 \text{ SRP20 nmol/mol} + 0.3 \text{ nmol/mol}$$

## 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.

Two calibrations were carried out and the second is detailed below.

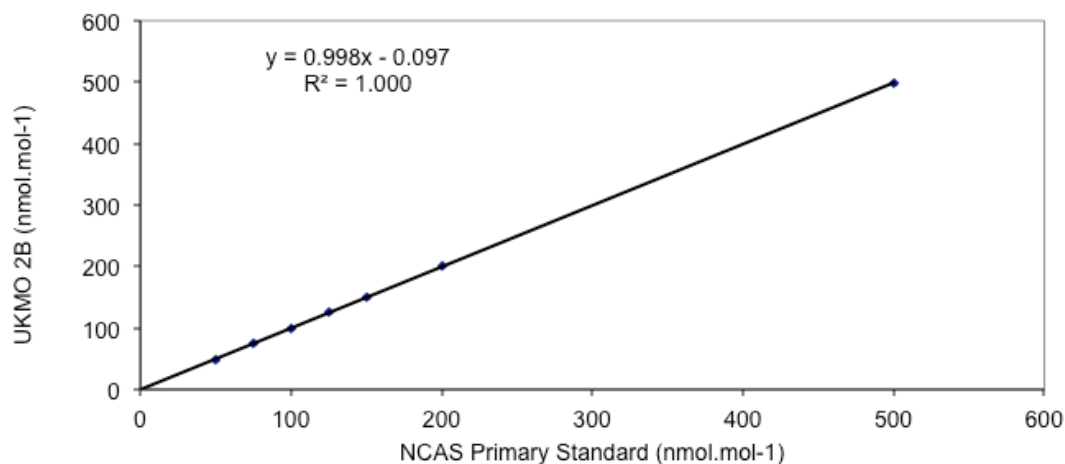
$$\text{UKMO 2B Ozone output in nmol/mol} = \mathbf{m} \text{ NCAS Primary Standard nmol/mol} + \mathbf{c}$$

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)	UKMO 2B (nmol/mol)	Standard deviation (nmol/mol)
-1.67	-0.17	0.22
50.02	49.15	0.62
100.01	98.67	0.32
149.95	148.94	0.99
200.02	200.17	0.74
74.97	75.04	0.56
125.00	124.64	0.39
500.10	499.46	1.24



**UKMO 2B Ozone nmol/mol = 0.998 NCAS PS nmol/mol – 0.097 nmol/mol**

The above equation is valid in the amount fraction range 0-500 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).

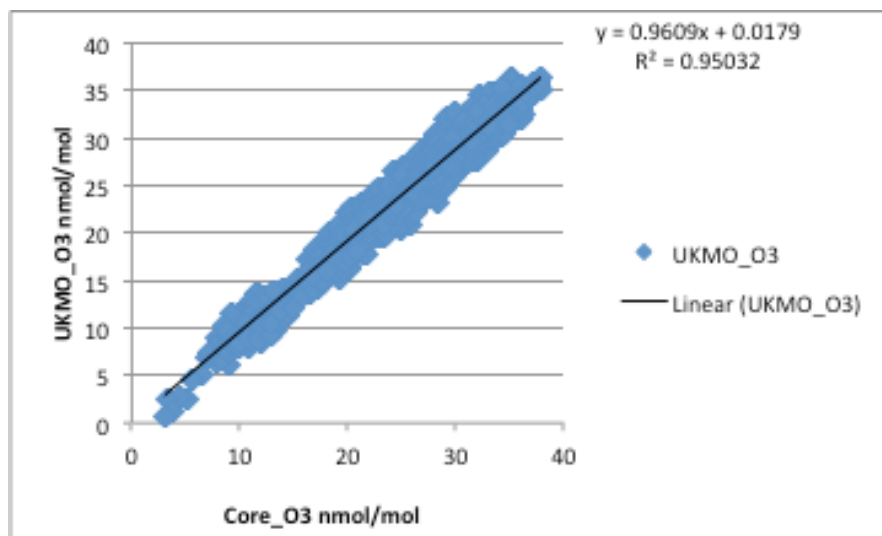
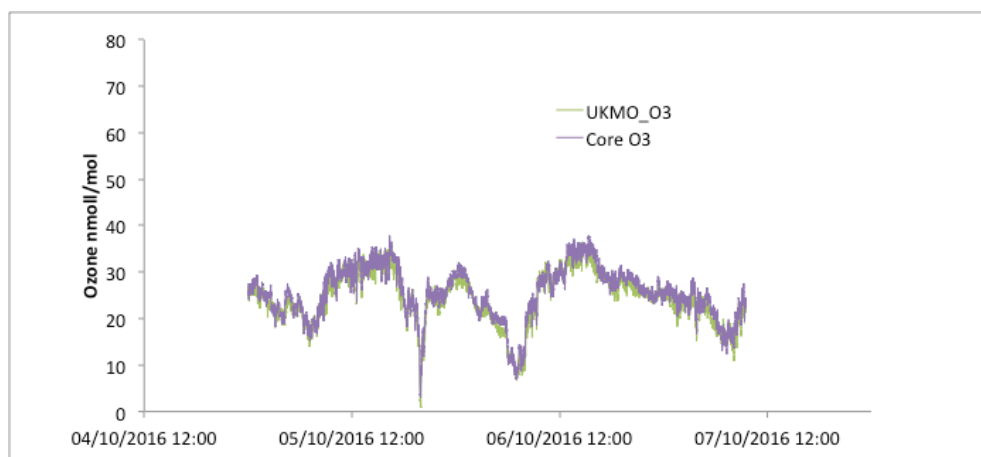
Precision of the instrument has been calculated using the zero data and by applying the following formula: -

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

**The precision is 0.66 nmol/mol for this instrument.**

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

The instrument was also run alongside a calibrated core instrument from the air-sampling manifold.



The results were fairly consistent with the calibration.

*This work was carried out in the COZI-Lab in the Wolfson Atmospheric Chemistry laboratories (WACL) at the University of York. The COZI-Lab exists to support the UK community and is an Atmospheric Measurement Facility (AMF) from the National Centre for Atmospheric Science (NCAS).*