U.S. Department of Commerce
National Institute of Standards and Technology
Chemical Science and Technology Laboratory
Analytical Chemistry Division
Gaithersburg, MD 20899-8393

REPORT OF ANALYSIS

July 7, 2003

Calibration of OREC Model DM100 Ozone Monitor, serial numbers 318, and 748

Submitted to:

Corporate Consulting Service, Inc., Akron, Ohio

Job # 3203

The OREC Model DM100, serial numbers 318 (OREC 318), and 748 (OREC 748), were calibrated by comparison with the NIST Standard Reference Photometer serial # 2 (NIST SRP 2). The comparisons were conducted at NIST in Gaithersburg, MD on May 28, 2003. Each comparison run consisted of measurements of ten different concentration levels with no measurements of zero concentration. The measurements of the ten concentration levels were randomly ordered.

The results obtained by NIST Standard Reference Photometers are based on a molecular absorption coefficient of 308.32 $cm^{-1} \times atm^{-1}$ (natural logarithm base)[a] referenced to 273.15 K and 101.3 kPa for ozone at 253.7 nm. The uncertainty with which the SRP assays ozone is fundamentally dependent on the uncertainty of the value of the ozone absorption coefficient at 253.7 nm. The estimated expanded standard uncertainties[b] of the SRP ozone concentration measurements are 1 ppbv[c] (absolute) in the 0 ppbv to 100 ppbv range and 1 % (relative) in the 100 ppbv to 1000 ppbv range.

Calibration Parameters for OREC 318, and OREC 748:

Powered on:	May 28, 2003, 10:00 AM.
Conditioning:	60 minutes at 530 ppbv prior to comparison runs.
Configuration:	NIST SRP 2 Ozone Generator, both OREC DM100s drawing sample and reference from NIST dual manifold.
Data Connection:	Analog Signal

---

[a] Paur, R.J., and McElroy, F.F., "Technical Assistance Document for the Calibration of Ambient Ozone Monitors", Page 3-9, *U.S. Environmental Protection Agency Research Report, EPA-600/4-79-057*, September 1979.

[b] Taylor, B.N., and Kuyatt, C.E., "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results", *National Institute of Standards and Technology Technical Note 1297*, 1994 Edition (U.S. Government Printing Office, Washington, D.C., September 1994).

[c] The unit parts per billion by volume (ppbv), which is equivalent to nmol/mol, is most commonly used in ozone calibration work and hereafter will be exclusively used in this report.

Results:

An average linear regression equation for the nine comparison runs between OREC 318 vs. NIST SRP 2 is given below:

$$\text{OREC 318} = [(1.0062 \times \text{NIST SRP 2}) + 6.2] \text{ ppbv}$$

Data Summary:

Run File Name	Concentration Range (ppbv)	Slope	SU-Slope	Intercept (ppbv)	SU-Intercept (ppbv)	RSD (ppbv)
c0528001	80.5 - 532.4	1.00371	0.00266	6.096	0.899	1.161
c0528002	80.5 - 532.9	1.00445	0.00262	7.130	0.884	1.145
c0528003	79.9 - 534.1	1.00983	0.00121	5.558	0.409	0.531
c0528004	79.1 - 530.7	1.00559	0.00233	7.208	0.784	1.015
c0528005	**79.0 - 533.1**	**1.00898**	**0.00242**	**5.941**	**0.815**	**1.057**
c0528006	78.7 - 533.1	1.00512	0.00240	6.240	0.806	1.046
c0528007	78.7 - 531.9	1.00644	0.00230	6.007	0.772	1.002
c0528008	79.9 - 530.6	1.00847	0.00264	5.226	0.887	1.150
c0528009	79.5 - 531.3	1.00301	0.00172	6.738	0.577	0.748
	Average:	**1.00618**	**0.00226**	**6.238**	**0.759**	**0.984**
	Std. Dev.:	**0.00243**	**0.00048**	**0.674**	**0.163**	**0.211**

Concentration range determined by NIST SRP 2.
Note: Residual is defined as the observed value minus the corresponding fitted value.

An average linear regression equation for the nine comparison runs between OREC 748 vs. NIST SRP 2 is given below:

$$\text{OREC 748} = [(1.0176 \times \text{NIST SRP 2}) - 10.5] \text{ ppbv}$$

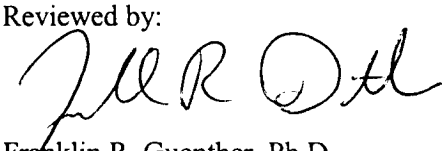
Data Summary:

Run File Name	Concentration Range (ppbv)	Slope	SU-Slope	Intercept (ppbv)	SU-Intercept (ppbv)	RSD (ppbv)
c0528001	80.5 - 532.4	1.01633	0.00475	-9.822	1.604	2.071
c0528002	80.5 - 532.9	1.01139	0.00454	-8.082	1.533	1.985
c0528003	79.9 - 534.1	1.01296	0.00747	-6.561	2.521	3.272
c0528004	79.1 - 530.7	1.01491	0.00629	-8.347	2.115	2.738
c0528005	79.0 - 533.1	1.01536	0.00704	-9.654	2.370	3.071
c0528006	78.7 - 533.1	1.02719	0.00488	-15.163	1.639	2.128
c0528007	78.7 - 531.9	1.02665	0.00603	-14.191	2.028	2.633
c0528008	79.9 - 530.6	1.02153	0.00625	-11.956	2.101	2.721
c0528009	79.5 - 531.3	1.01200	0.00788	-11.074	2.639	3.427
	Average:	**1.01759**	**0.00613**	**-10.539**	**2.061**	**2.672**
	Std. Dev.:	**0.00607**	**0.00121**	**2.850**	**0.405**	**0.527**

Concentration range determined by NIST SRP 2.
Note: Residual is defined as the observed value minus the corresponding fitted value.

Prepared by: James E. Norris, Electronics Technician

Reviewed by:



Franklin R. Guenther, Ph.D.
Supervisory Research Chemist