

U.S. Department of Commerce
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REPORT OF ANALYSIS

September 7, 2005

Calibration of OREC Model DM100, serial number 748 Ozone Monitor

Submitted to:

Corporate Consulting Service, Inc., Akron, Ohio

Job Number: 5171

The OREC Model DM100, serial number 748 Ozone Monitor (OREC748), owned by Corporate Consulting Service, Inc. was calibrated by comparison with the NIST Standard Reference Photometer serial #2 (NIST SRP 2). The comparisons were conducted at NIST in Gaithersburg, MD over the period August 17-18, 2005. Each calibration consisted of measurements of ten different concentration levels and two measurements of zero concentration. The measurements of the ten concentration levels were randomly ordered, while the measurements of zero concentration were obtained at the beginning and end of each comparison run.

The results obtained by NIST Standard Reference Photometers are based on a molecular absorption coefficient of $308.32 \text{ cm}^{-1} \times \text{atm}^{-1}$ (natural logarithm base) [1] 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 [2] of the SRP ozone concentration measurements are 1 ppbv¹ (absolute) in the 0 ppbv to 100 ppbv range and 1 % (relative) in the 100 ppbv to 1000 ppbv range. The SRP uncertainties are being examined more thoroughly and may change in the future. NIST does not make any claims as to the future performance of the OREC748, but is merely reporting the data obtained while operated at NIST.

Calibration Parameters for OREC 748:

Powered on: August 17, 2005, 10:35 AM.

Conditioning: 1-2 hours around 900 ppbv, then 60 minutes at 927 ppbv prior to calibration.

Configuration: Drawing Sample Gas from NIST SRP Sample Manifold.
Drawing Reference Gas from NIST SRP Reference Manifold.

Data Connection: Analog.

¹ 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.

The OREC748 was initially set up and powered on at 10:35 AM on August 17, 2005 and connected to the SRP control system via analog signal connection. The OREC748 sample and reference inlets were connected to the SRP sample/reference manifold using 1 meter of Teflon tubing for each. The OREC748 was then allowed to sample approximately 927 ppbv over a 1-2 hour period before beginning the official calibration runs. After the span values were set by CCSI personnel, a set of 8-comparison runs were performed overnight starting on July 17, 2005 up to a maximum ozone concentration of 937 ppbv.

The results of the comparison runs performed in this report are given below. A graphical representation of the data presented in this report can be found in Appendix I. The individual calibration report files and an Excel spreadsheet summary are provided on a CD with this report.

Results:

The following average linear regression equation was obtained from the set of 8-comparison runs.

$$C_{\text{OREC748}} = [(1.00347 \times C_{\text{SRP 2}}) - 1.2] \text{ ppbv}$$

Where, C_{OREC748} = ozone concentration (ppbv) determined by the OREC DM100, serial # 748.

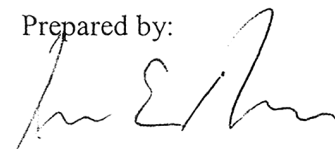
$C_{\text{SRP 2}}$ = ozone concentration (ppbv) determined by the NIST SRP 2.

Data summary from individual calibration runs:

FileName	Date	Max conc.	OREC748 Slope	OREC748 u-slope	OREC748 Intercept	OREC748 u-intercept	OREC748 RSD
c0817001.xls	17-Aug-05	927.2	1.00220	0.00231	-0.54189	1.10276	2.37737
c0817002.xls	17-Aug-05	932.5	1.00451	0.00288	-3.09930	1.38219	2.98073
c0817003.xls	17-Aug-05	935.7	1.00582	0.00281	-3.41546	1.35197	2.91630
c0817004.xls	17-Aug-05	937.7	1.00106	0.00173	-0.75674	0.83766	1.80664
c0817005.xls	18-Aug-05	938.0	0.99938	0.00290	1.02451	1.40351	3.02526
c0817006.xls	18-Aug-05	939.5	1.00733	0.00247	-0.58221	1.19412	2.57500
c0817007.xls	18-Aug-05	940.2	1.00549	0.00373	-2.74648	1.80594	3.89548
c0817008.xls	18-Aug-05	941.3	1.00194	0.00211	0.33389	1.02243	2.20519
Average:		936.5	1.00347	0.00262	-1.22296	1.26257	2.72275
Std. Dev.:		4.7	0.00273	0.00061	1.65683	0.29420	0.63461

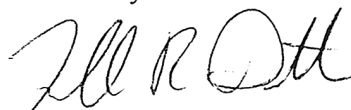
u = uncertainty, RSD = residual standard deviation.

Prepared by:



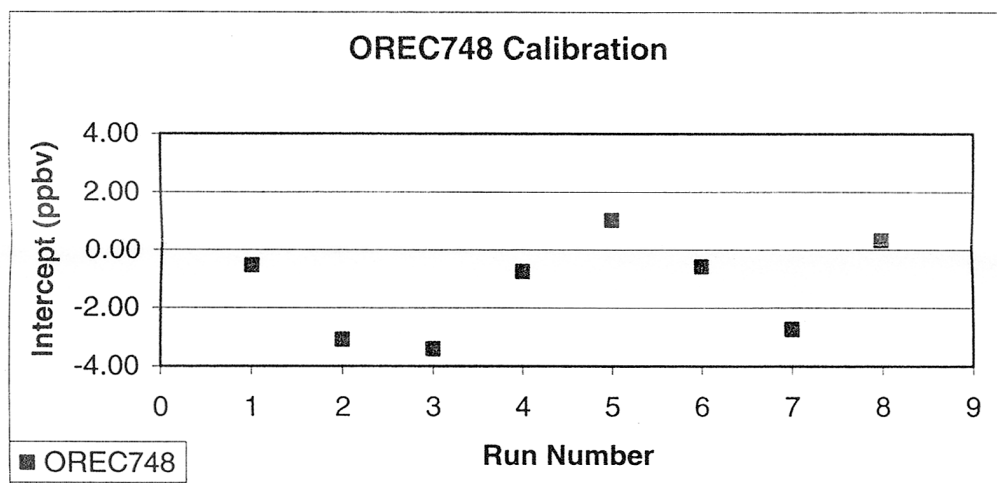
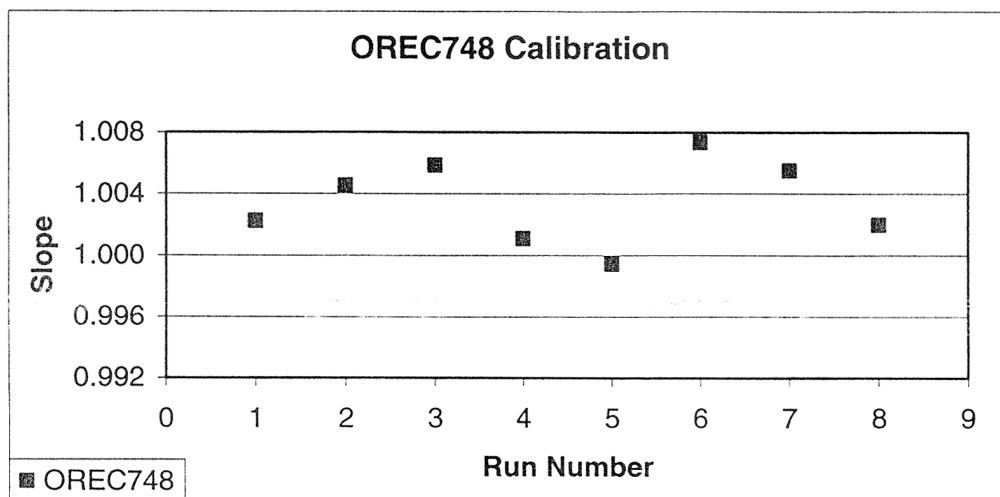
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Appendix I. Graphical summary of calibration data.



References

1. 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.
2. 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).