

Report on Brewer Spectrophotometers Calibration – Brazil, Bolivia – May 26-June 9, 2004

I. Overview and Instrument Status:

International Ozone Services Inc. (IOS) completed the ozone and UV calibration of five Brazilian (INPE) Brewer instruments during period May 26 – June 9, 2004 at four locations. Brewers #073 in Natal, #081 in Cuiaba, #056 and #124 at San Jose dos Campos and #110 in Bolivia were completed. Traveling Brewer #017 was used as the ozone reference instrument at each location.

The weather was not perfect but usually some opportunities were available each day for some ozone/UV comparative measurements. External UV lamp calibrations were done with IOS 50w lamps, which are traceable to NIST standards. Sun scan tests were done to determine the proper micrometer position, (operating wavelengths). The internal mercury lamp and an external cadmium spectral discharge lamp were used on each Brewer to measure the wavelength accuracy for UV scanning, ozone operating wavelengths and slit functions, (dispersion test).

II. Final Ozone/SO₂ Test Results:

On the next pages are graphs of ozone results at each site visited using final constants with each instrument and other test results.

III. Summary of results and changes:

Instrument.	#073 (Natal)	#081 (Cuiaba)	#124 (C.P.)	#056 (SJC)	#110 (La Paz)
Last SL ratios	1680 / 3225	1780 / 3220	1530 / 3180	1715 / 3430	2130 / 4010
SL ratios final	1690 / 3210	1780 / 3220	1415 / 3030	1690 / 3390	2080 / 3935
Change in SL	+10 / -15	0 / 0	-115 / -150	-25 / -40	-50 / -75
Comments	many adj. *	tracking ?	Etc's=2670/2668	repl. pc. board	adj. Mirror
Cal step	162 -> ok	296 ->ok	290 ->ok	162 -> 165	290 -> 292
DT now/set to	20 / 26 ns	35 / 35 ns	25 / 30 ns	35 / 35 ns	40 / 40 ns
Last ETCs	2890 / 2755	2960 / 2750	2759 / 2788	2845 / 3000	3365 / 3705
Change in ETCs	-20 / -66	0 / 0	-119 / -138	-15 / -100	-60 / -85
ETCs final	2870 / 2689	2960 / 2750	2640 / 2650	2830 / 2900	3305 / 3620
Absn. coeff's	0.3402 / 1.1423	0.3416 / 1.1445	0.3455 / 1.1515	0.3434 / 1.15	0.3443 / 1.1470
ICF file to use	Icf15004.073	Icf15304.081	Icf16704.124	Icf15604.056	Icf16004.110
DCF file to use	Dcf35496.073	Dcf15304.081	Dcf18496.124	Dcf15604.056	Dcf16004.110
Uv resp. in use	Uvr31300.073	Uvr23401.081	Uvr07800.124	Uvr07600.056	Uvr31300.110
New UV resp.	Uvr15104.073	Uvr15404.081	Uvr15704.124	Uvr15604.056	Uvr16004.110
New/old ratio	-40%	~-16%	~ -24%	-12%	~ -22%

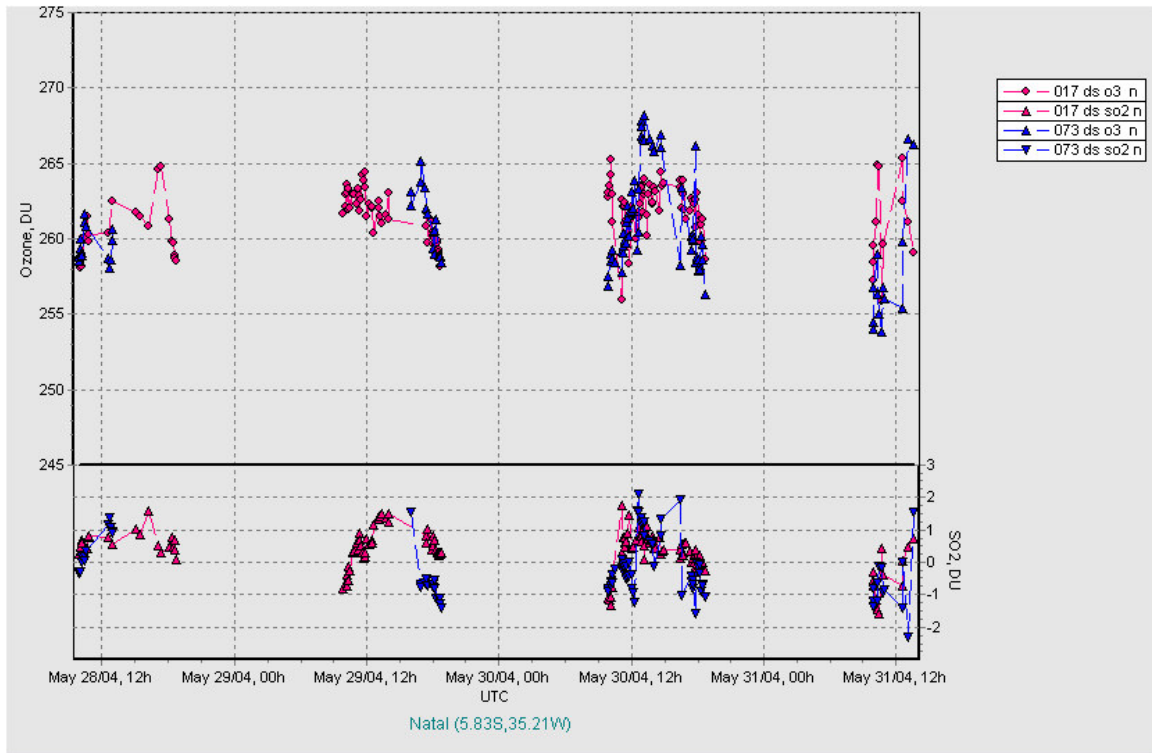
#073 - pmt filter cleaned, shutter motor replaced, adjust corr. lens on #073, pmt is weak., R6 was 1410

IV. Servicing and Software Changes:

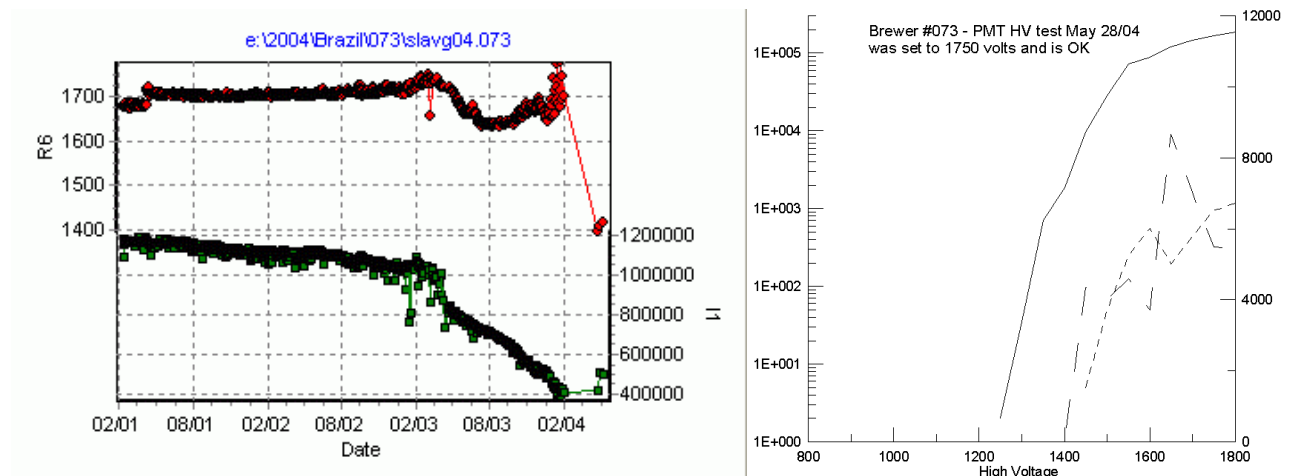
All received the standard maintenance checks, cleaning and lubrication of micrometer drives. The azimuth tracker drive wheels were cleaned and tensions adjusted where necessary. The system leveling and tracking was improved on all except #110. The servicing completed on each instrument included improving cover sealing gaskets and replacement of all shock mount seals. #073 required the most service since it had been inoperative for many months with power supply failure plus other problems. The PMT UV filter was cleaned to improve sensitivity and the shutter motor replaced. The most recent software control programs (V375f from IOS) was installed on each computer and checked.

Brewer #073 Natal, Brazil - Final Ozone/SO₂ and Other Test Results – May 28-31, 2004

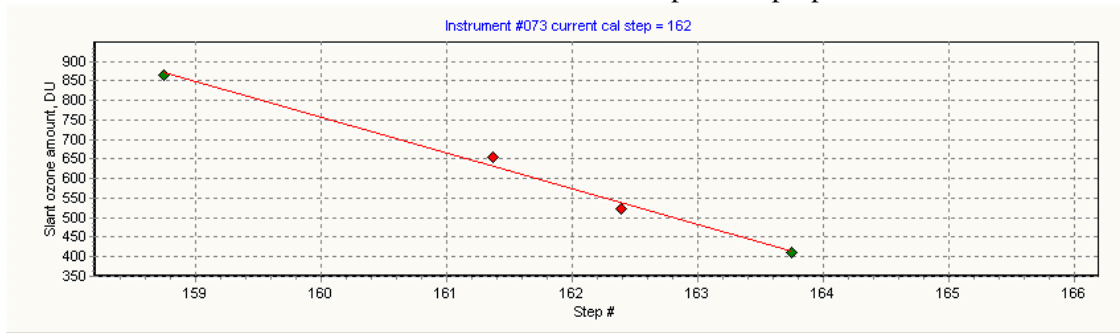
Below are the Natal final Ozone/SO₂ results over the four days with #017. For the first day the ETC constants were set to 2650/2240 for the initial calibration and then the rework was done on the instrument. The final ETC constants were 2870/2689 when standard lamp ratios were 1690/3210.



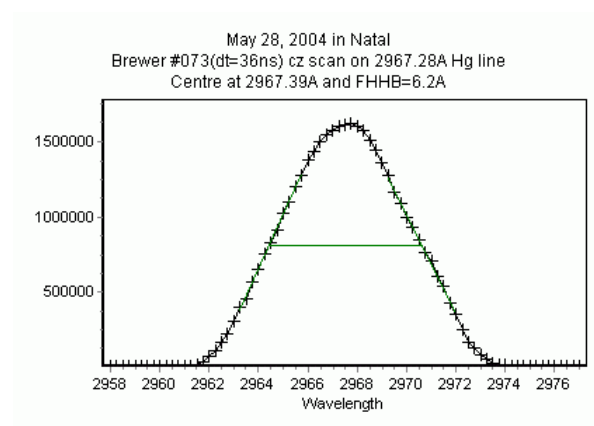
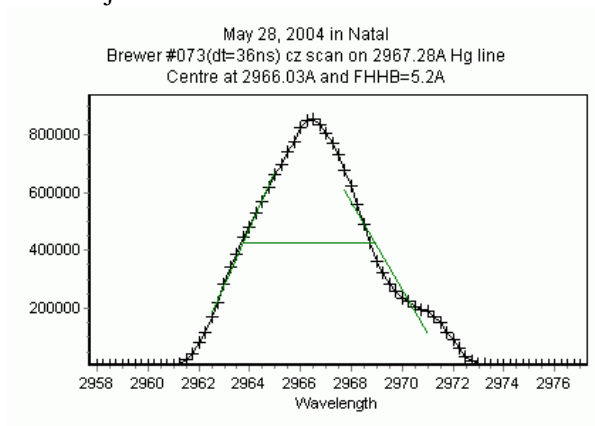
Below is a graph of the SL R6 (ozone) ratio and F1 counts results since 2001, which show the major decrease occurred in 2004 during the period when instrument was not working. The high voltage test results are shown on the right and show that the PMT requires higher than normal voltage to operate properly and was set to 1700 volts.



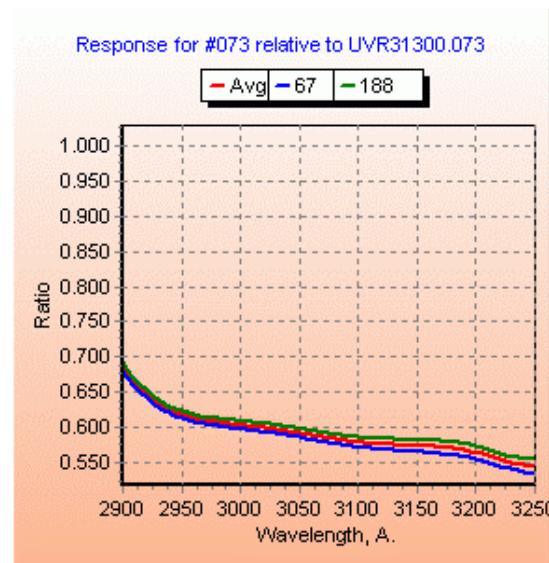
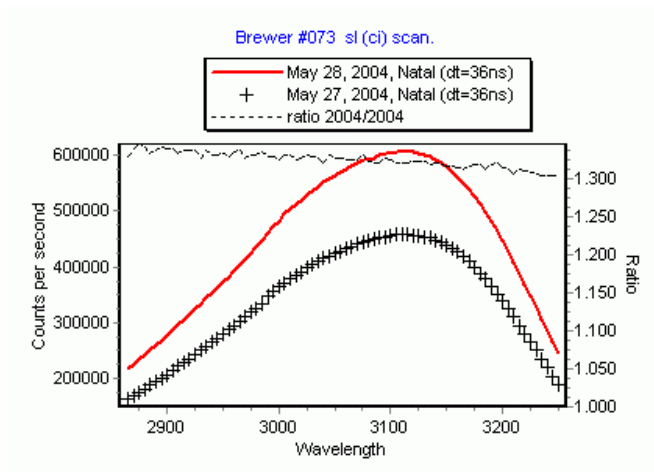
Below are the sun scan results from #073 which show cal step 162 is proper.



Below are two scans of mercury lamp line 296.7 nm. which show the improvement in slit function after a small adjustment to correction lens.

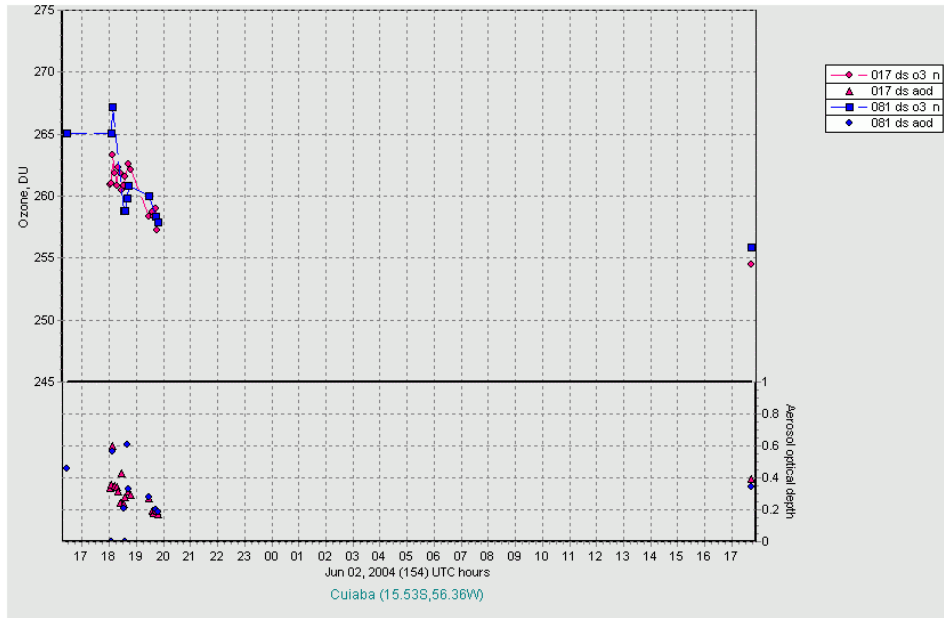


After servicing the sensitivity increased by 30%, as shown below in CI scans of standard lamp. In the next graph the final response file (uvr15104.073) is compared to the 2000 response file. Note that the instrument sensitivity is ~40% lower which indicates likely that the PMT filter will need to be replaced in the near future, especially if SL ratios become instable.

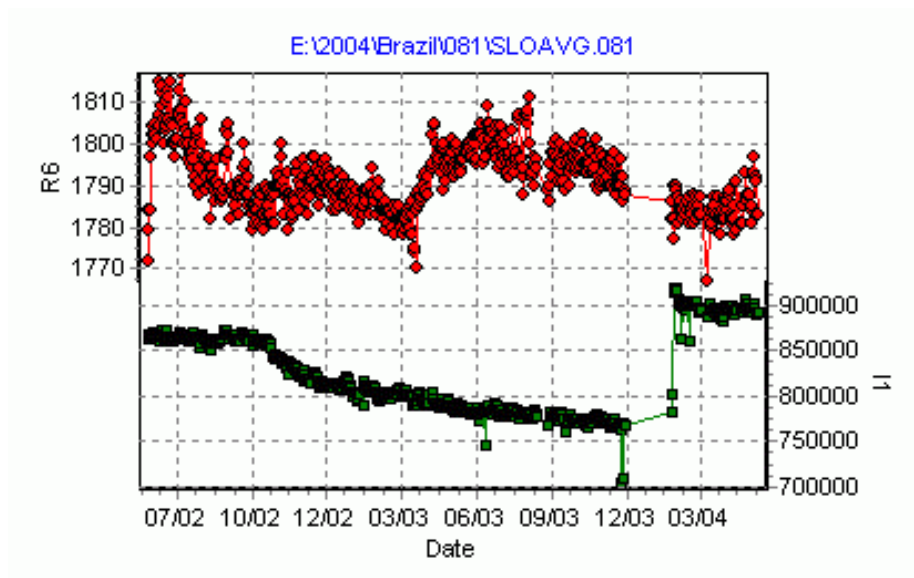


Brewer #081 Cuiaba, Brazil - Final Ozone/AOD and Other Test Results – June 1- 2, 2004

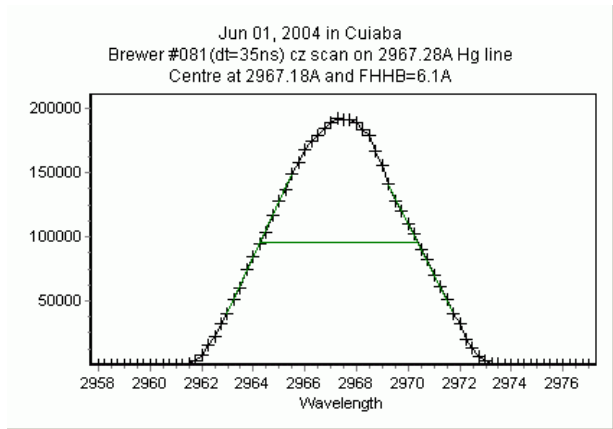
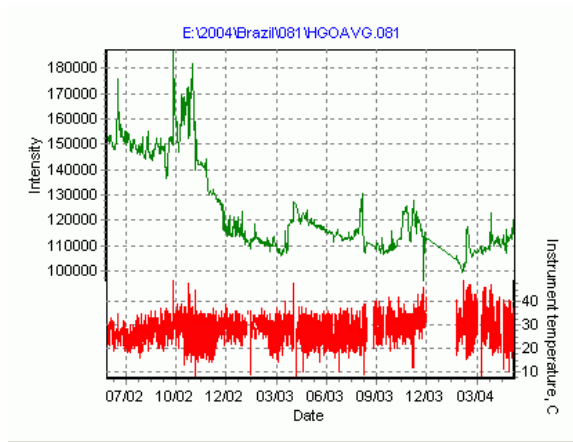
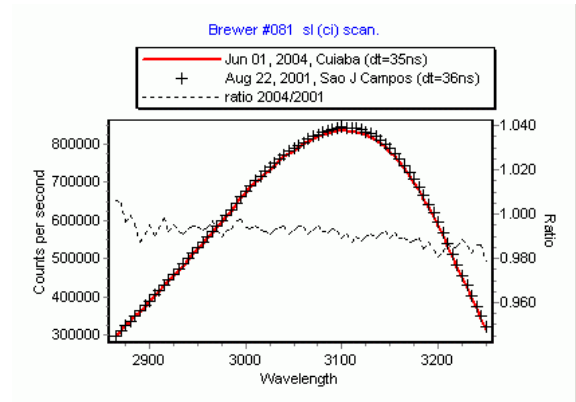
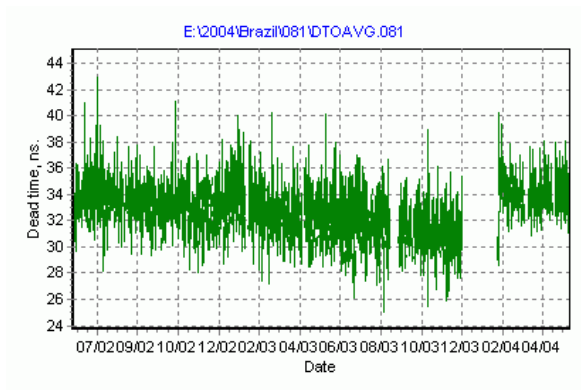
Below are the final Ozone/SO₂ results over two days with #017. The ETC constants were not changed (were 2960/2715 since 099/03) when standard lamp ratios were and continue to be 1780/3220. Strange tracking corrections had to be made and problem was traced to zenith steps per revolution constant set at 2710 instead of 2816. It is suspected that this would affect some previous data when sun was being partially blocked.



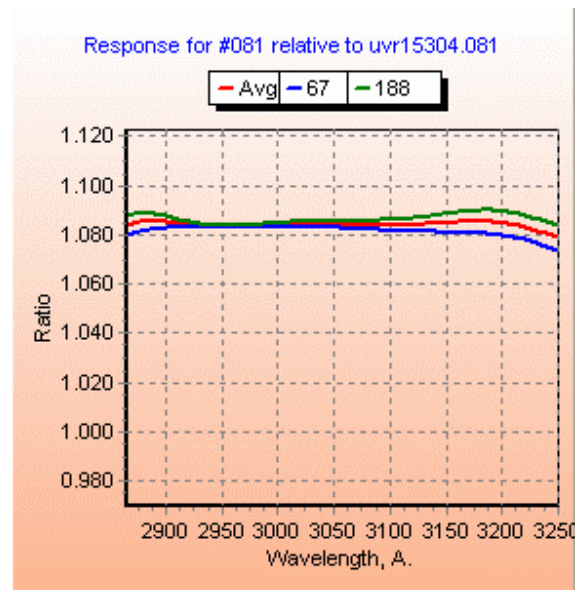
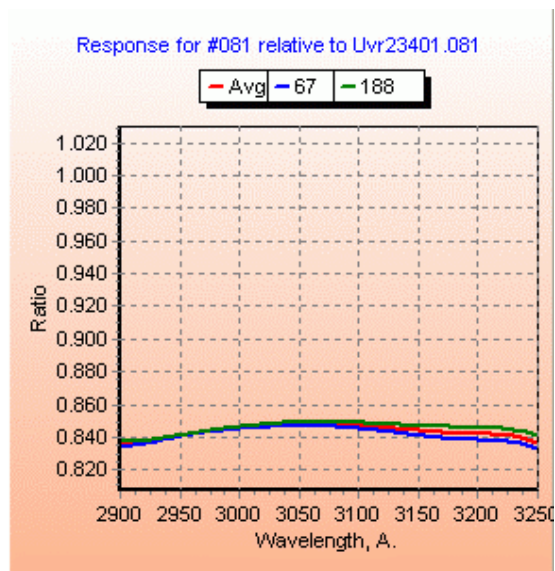
Below is graph of the SL R6 (ozone) ratio and F1 counts results since 2002, and on the next page are graphs of dead time DT, HG intensity and SL scans comparison to 2001 - which show the quite good stability.



Brewer #081 graphs continued:

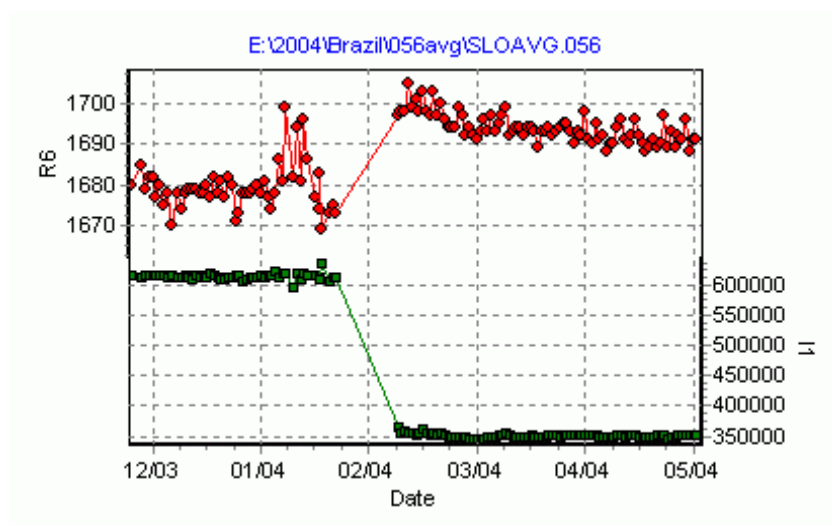
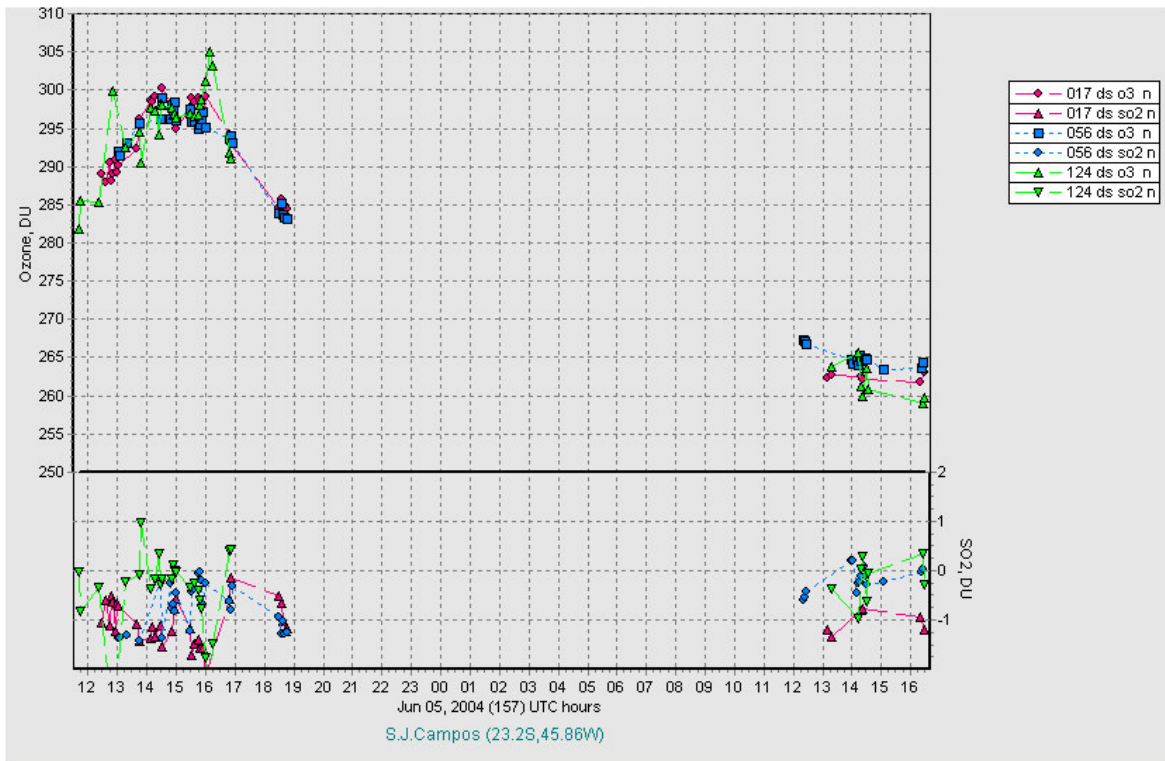


Reference left graph below showing that the UV sensitivity has decreased by 16% since 2001, this was after the uv prism alignment (constant) was improved (TU test), note the sensitivity went up 8% after.

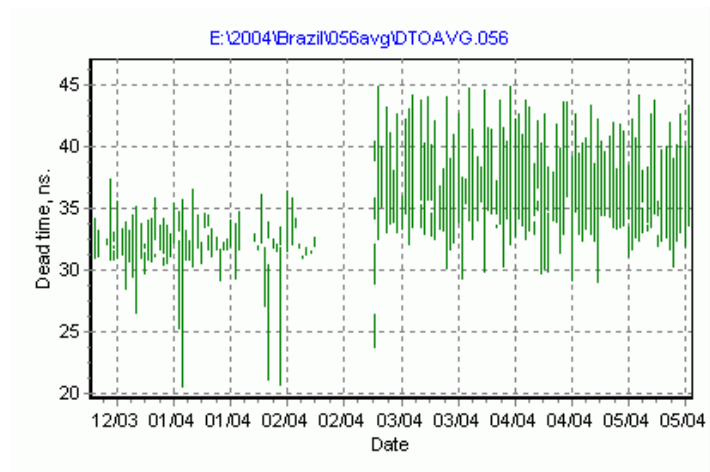
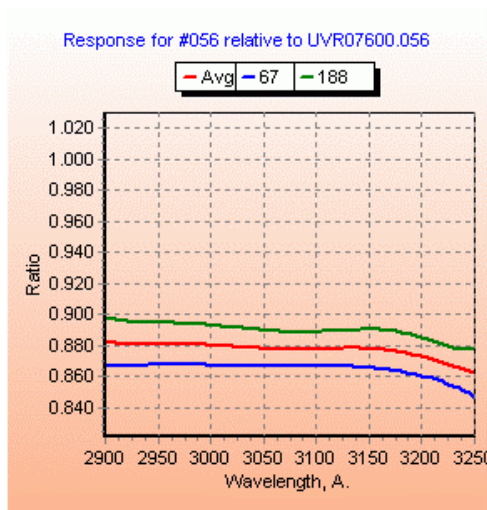
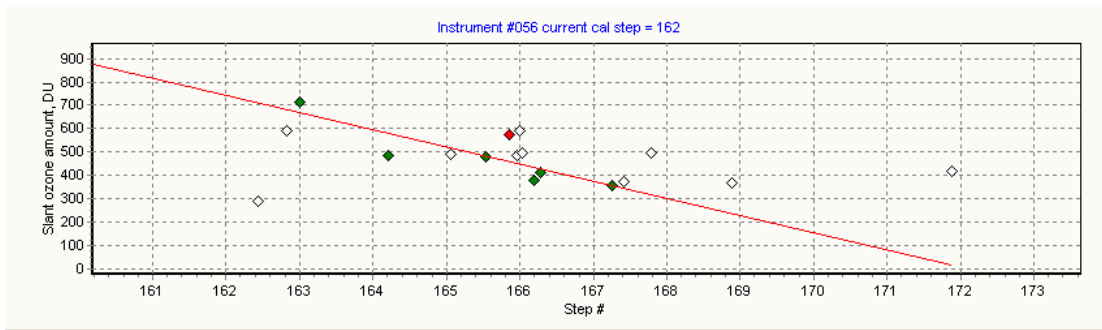
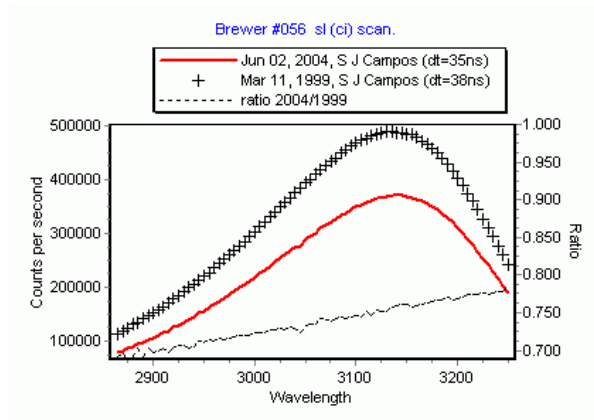
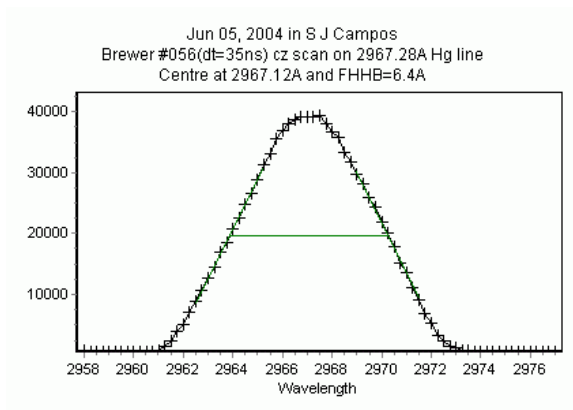


Brewers #056, #124 SJ Campos, Brazil - Final Ozone/SO₂ and Other Test Results – June 4-5, 2004

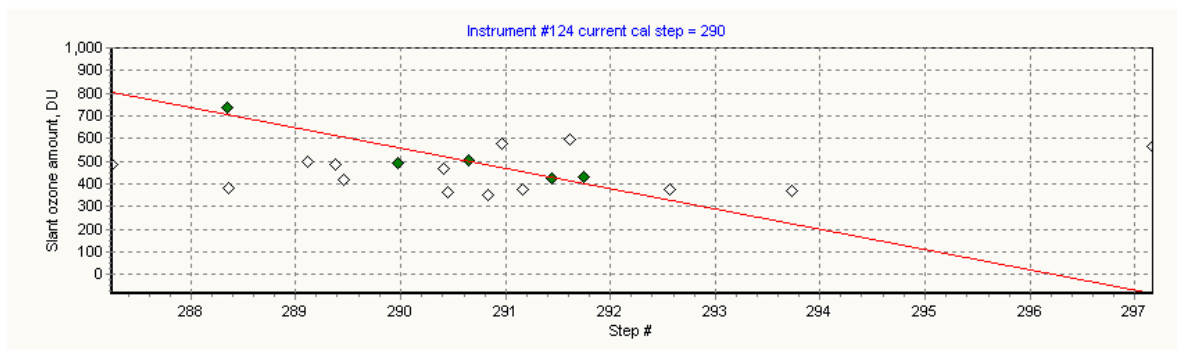
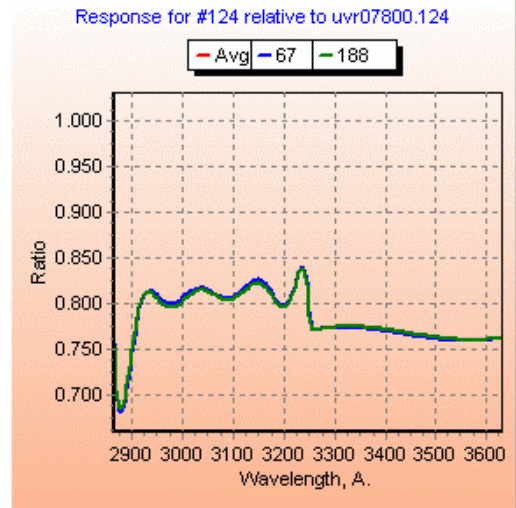
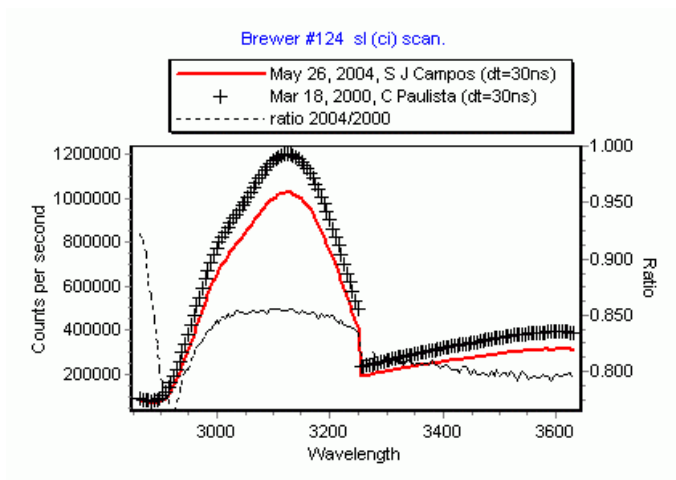
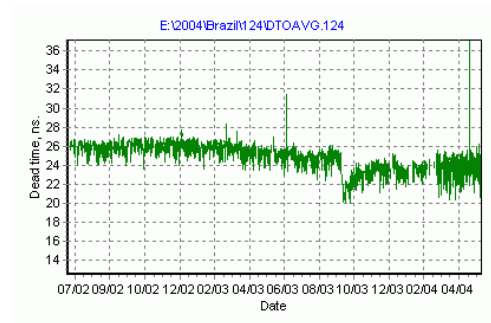
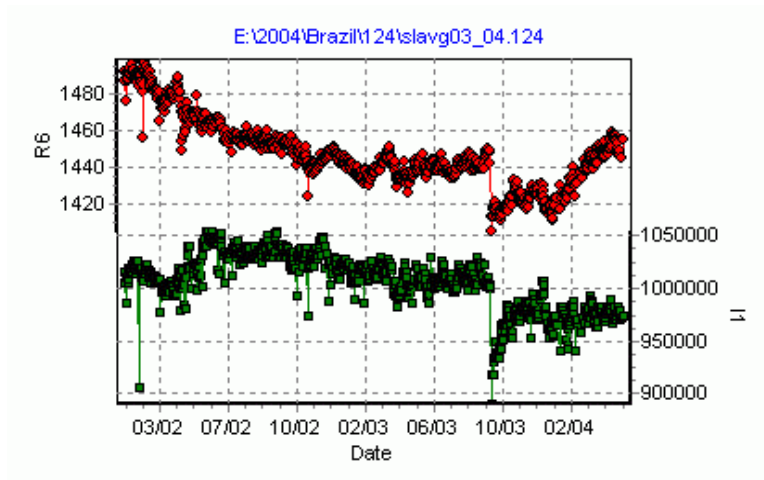
Below are the final Ozone/SO₂ results over the two days with #017. With no changes the ozone was ~1% lower with #056 and ~2% lower with #124 when compared to the standard #017. The ETC constants in use with #124 had been adjusted one year ago to 2670/2668 and now due to recent decrease in SL ratios to 1415/3030 the ETC's were adjusted to 2640/2650. For #056 the ETC constants have been set at 2845/3000 since 077/00 and now were adjusted to 2830/2900 for standard lamp ratios of 1690/3390. The photon counter board was exchanged in #056 to hopefully reduce errors. Corrections to constants have been done externally at INPE based on SL ratio values.



Brewer #056 graphs continued:

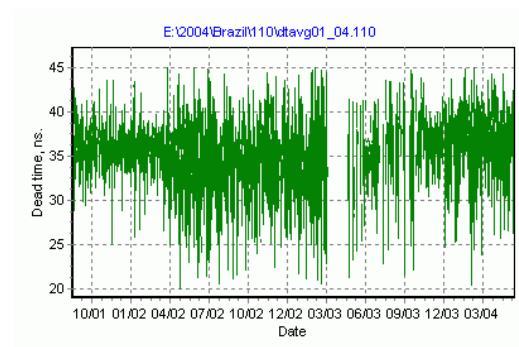
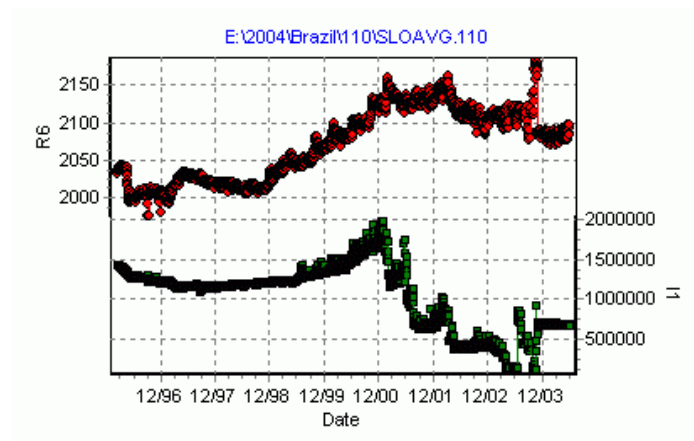
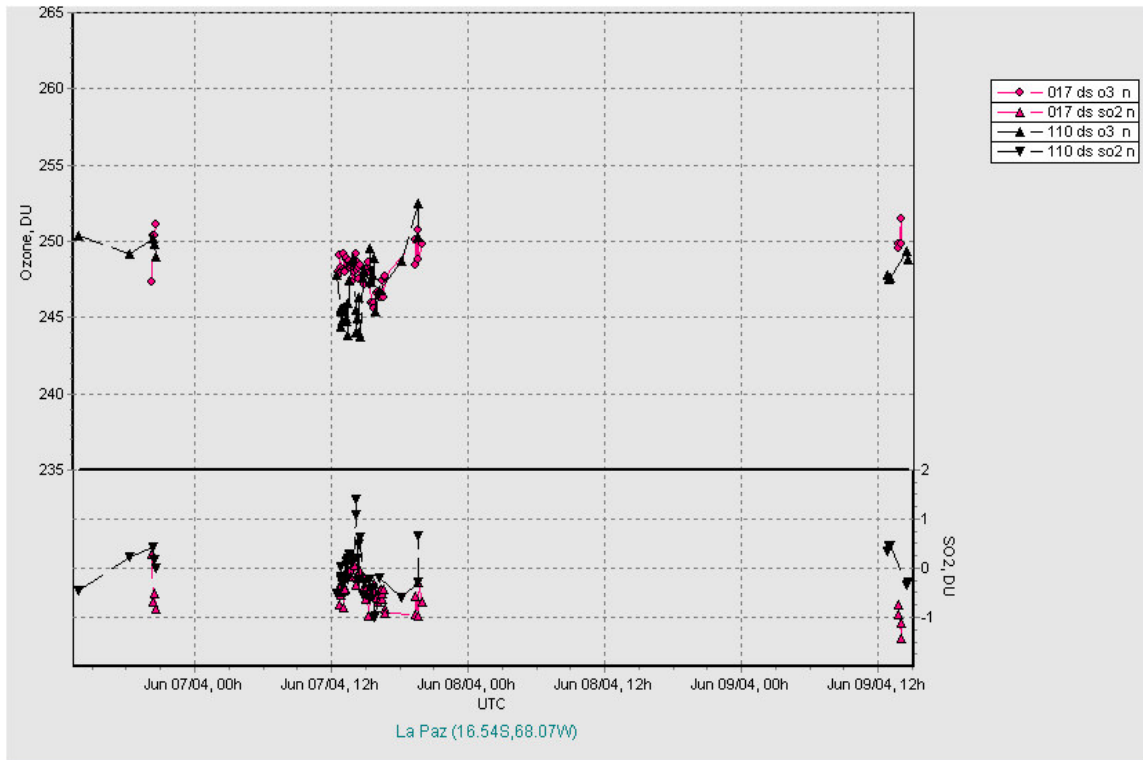


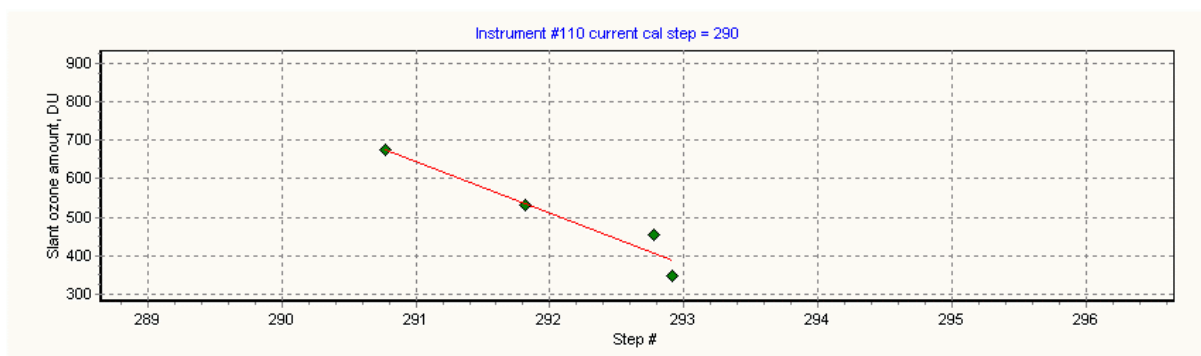
Below are SL, DT and other graphs of **Brewer #124**, normally located at C. Paulista site. Note the somewhat unstable SL ratio R6 and stable DT results since 2002. Note the decrease in sensitivity of 20-24% since 2000, which is shown in internal standard lamp and external UV lamp scan test results.. The sun scan results show cal step 290 is proper.



Brewer #110 La Paz, Bolivia - Final Ozone/SO₂ and Other Test Results – June 7-9, 2004

The initial ozone from #110 was 1-2% lower than #017. Below are the final Ozone/SO₂ results over three days with #017 when the ETC constants were reduced from 3365/3660 to 3305/3620 for SL ratios of 2080/3935. The instrument has been fairly stable for the past 3 years. The instrument has had a lower than normal maximum wavelength scanning limit (360 instead of 363nm) and so adjustments were made to the mirror to correct this weakness. So now standard UX scans can be done. On the last day some boards were damaged by an electrical shorting accident and had to be replaced by borrowing from #017.





After the above sun scan tests the cal step was adjusted to step 292 on #110. The graphs below show a normal slit function and that the UV sensitivity has decreased by 10% since 2001.

