

Calibration Report on Brewers #157, #183 and #033; Izaña, Spain; September 9-13, 2003

I. Overview and Instrument Status:

The original MKIII Brewer #157 has very stable in the past years. The instrument's constants in use were from 2001. Set at these values, the ozone readings were once again slightly higher than traveling standard instrument #017. Standard Lamp (SL) ratios R6/R5 were still at 2001 values of 339/575.

Brewer #033, a MKII instrument has been operated at sea level in Santa Cruz during the past four years and was re-located here for this calibration. It was working well and its SL ratios of 2103/3955 have been more stable with only a small decrease the past year. The ozone results were low by ~1% initially.

The new MKIII #183 with new electronics was working well and its SL ratios have remained stable at values of 386/755 since it was installed late last year. However the UV stability has been poor (~+/-10%) and has been detected with external UV lamp QL tests. Some tests and adjustments were made during this visit but without success. The UV instability was detected by comparing simultaneous UV scans to #157. After a high voltage (HV) test was done on day 259 the HV setting was increased by 50 volts. The ozone results from #183 did not have any apparent instability but were low by ~1% using its original factory calibration constants. New absorption coefficients from dispersion tests and ETC constants made the results more agreeable to #017 and #157.

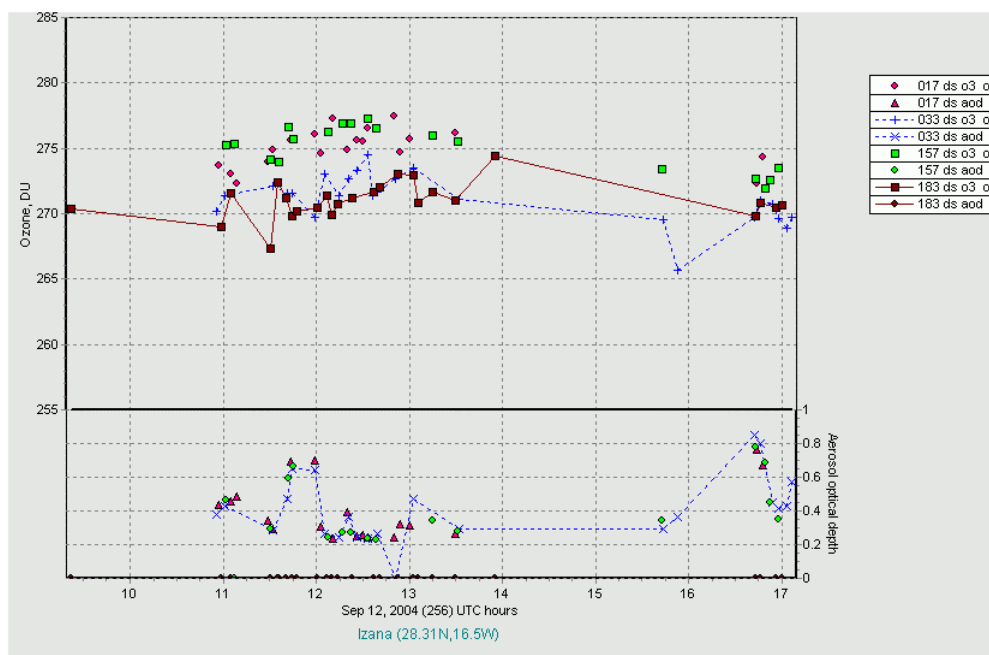
II. Summary of results and changes:

	#033	#157	#183
SL ratios 2004	2102 / 3950	339 / 575	386 / 758
SL ratios change from 2003	-5 / -20	n/c	n/c
ETC constants 2004 (change?)	3390 / 3575 (-10/-20)	1584 / 210 (n/c)	1650 / 370 (9/-24)
ETC constants last cal	3400 / 3595	1584 / 210 (1575 in use)	1641 / 394
Cal step (change?)	921 (n/c)	1027 (n/c)	285 (n/c)
Absorption Coeff's (change)	.3365 / 1.1362 (n/c)	.3397 / 1.15 (n/c)	.3405 / 1.146 (-1.4%)
ICF file recommended	icf26004.033	icf25603.157	icf25904.183
DCF file recommended	dcf27900.033	dcf25601.157	dcf26004.183 (new)
DT present/last/setting	40 / 40 / 40	33 / 32 / 32	22 / 26 / 26 final 26
GS const. (change?)	n/a	.998, -10 (n/c)	.9928/8 (new)
CI with SL	+30% to 25403	- 8% to 25403	-20% -> +6%
CZ on 2967/3341 Hg lines, sf	ok, .62nm	ok, .63nm/.57nm	ok, .61nm / .55nm
Adjustments made	only optics leveling	none	hv +50v, mic.2 loc.
UV response - lamps 1080-82	uvr26004.033	uvr26004.157	uvr26004.183 (n.d.1)

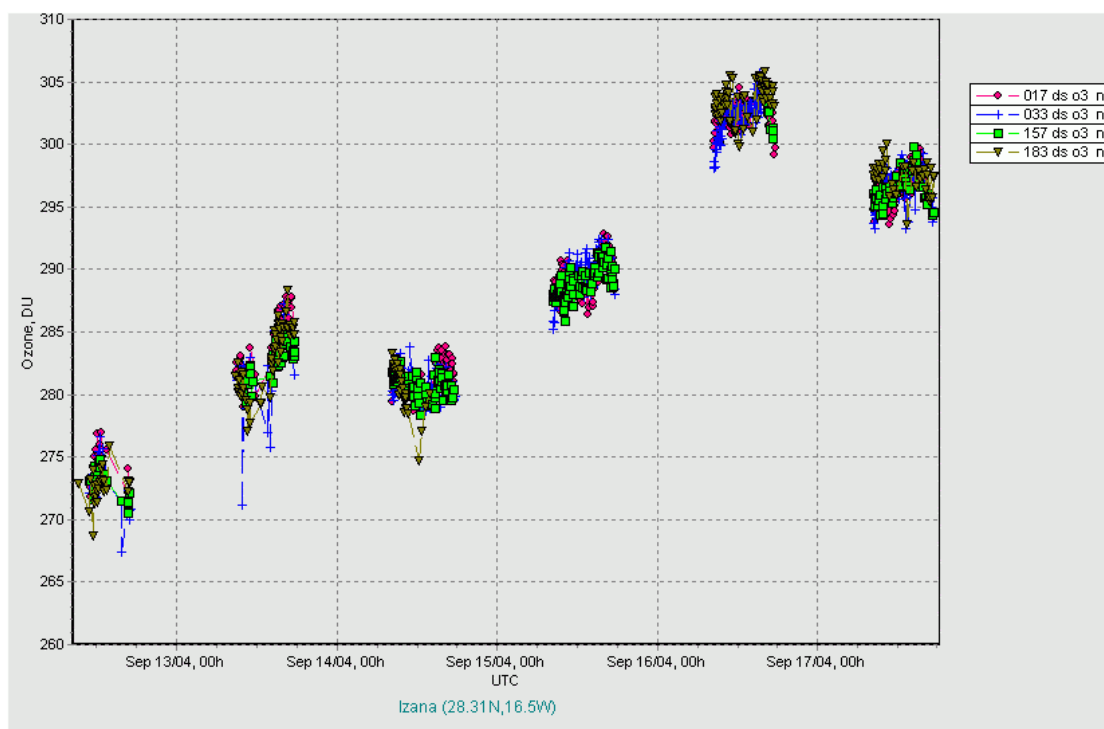
III. Ozone Test Results:

The weather co-operated well, especially the last 4 days for many Direct Sun observations and simultaneous UV scans, (dependent on instrument servicing and other tests and calibrations completed). Traveling standard Brewer #017 was again used. It has had some temperature dependency shifts recently but was stable during this period. It was checked against the Canadian triad before and after this visit. #157 results once again showed improved agreement to #017 with ETC constants of 1584/210 rather than 1575/210 in local use. Reference page 7, the self calibration (Langley ETC plot) results from this data supported the values of the final recommended ETC constants. The sun scan results for all three instruments showed that their existing cal step settings were proper.

Initial results from the first day Sept. 12 are shown below, note the lower ozone results of #033 and #183 but the good agreement of AOD of #033 and #157 with #017.



Below are the final ozone results of all ozone calibration data collected using recommended constants as listed on page 1. During the last 4 days there were periods when servicing was done, one at time.



IV. UV calibration results:

Three local 1000w lamps (1080-820) and some small 50w lamps were used this year for UV calibrations and the new response results compared to response files in use. The first neutral density filter was put into use on #183 for UV measurements due to its sensitivity level and being located at a high altitude site. The results from #157 and #033 compared well to last year's response files, -2% for #157 and -3% for #033 (+/-1% in lamp deviation). The comparison of processed results of timed UA scans from the three instruments and DUV results were found to be acceptable. Dispersion tests were completed on all with spectral lamps and only #183 showed a need to change its constants (dcf) file. There were accuracy improvements especially above 340nm. on slits 1 and 5 used for UV scanning when the new file was compared to the original.

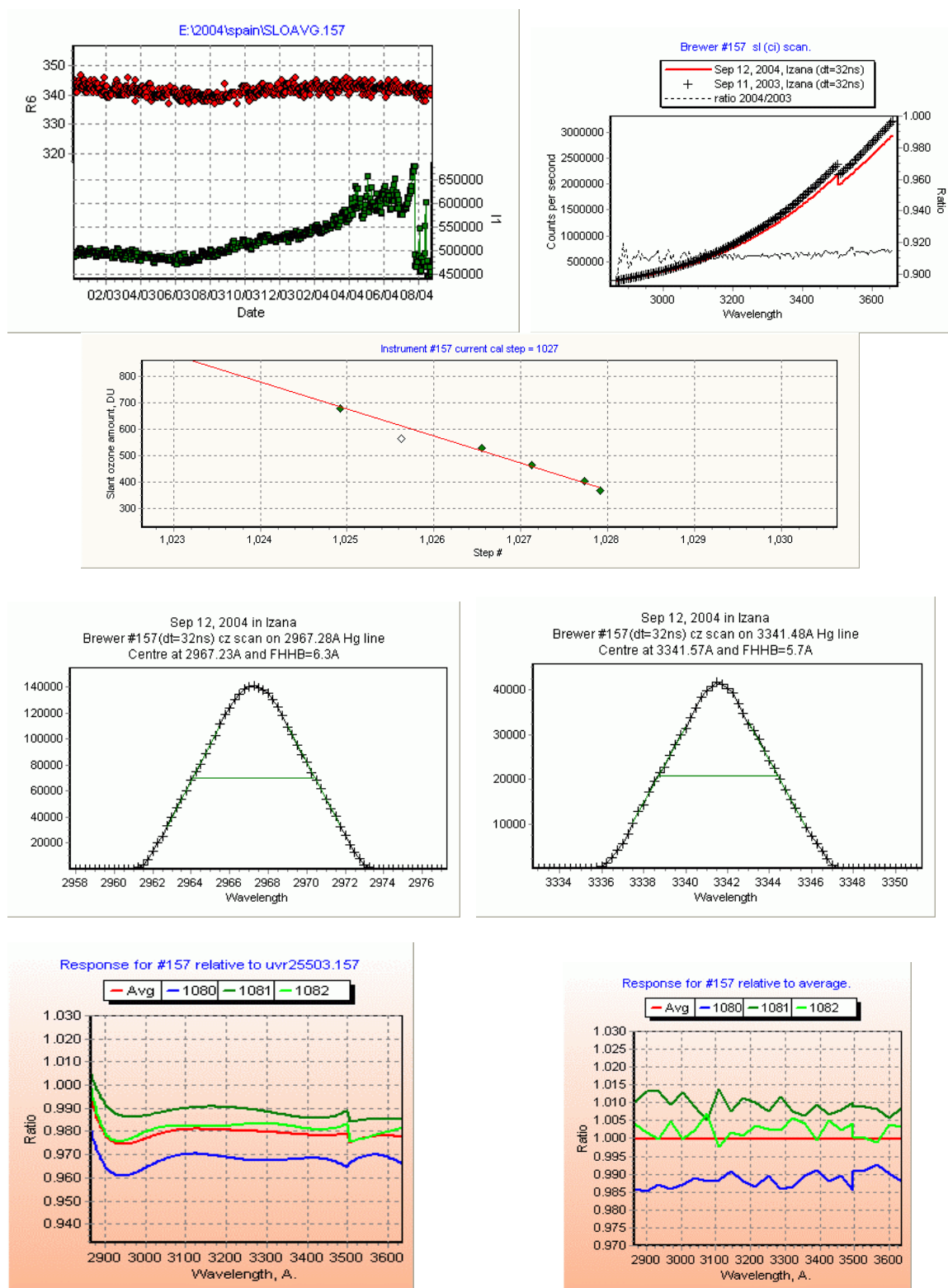
V. Servicing and Software changes:

The shock mount rubber seals on #183 and #157 were replaced and seals around the leveling screws were installed on #033 and #183 trackers. The second micrometer on #183 was re-located slightly to improve scanning to zero step position. The micrometer constants were then edited to the average results of the micrometer reset (FR) test. Cleaning and lubrication as required was done to micrometer gears and bearings. The sun tracking of #033 was found to be varying (especially north correction) more than normal and so the leveling screws in tracker were adjusted.

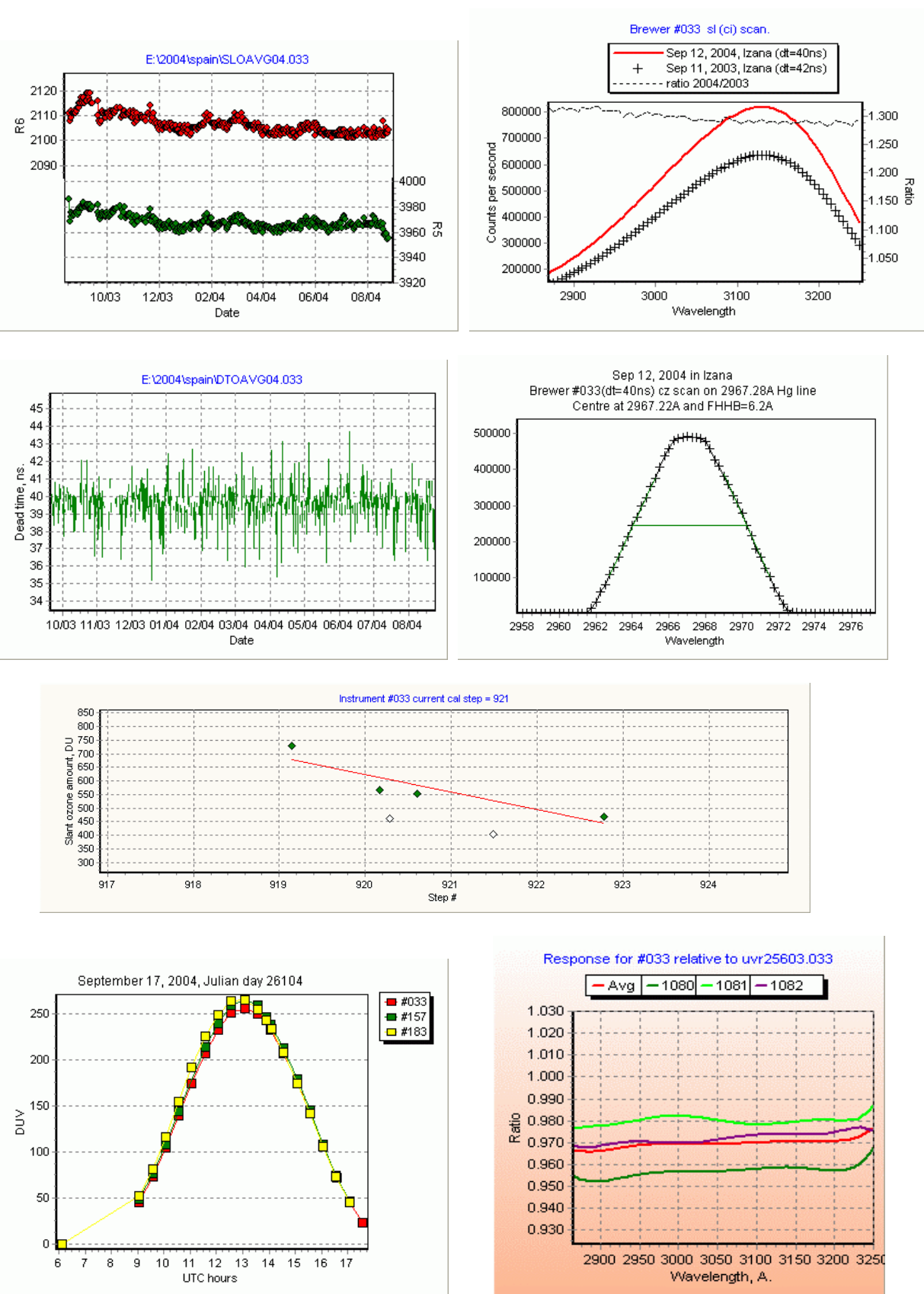
The most recent software control programs (V375f from IOS) were installed and checked on #183. A revised UV routine was left in operation, which records UV measurement times and results into B-files. The new DT and RS routines also record results into the B-files.

VI. Izaña Brewers report 2004 (Graphs):

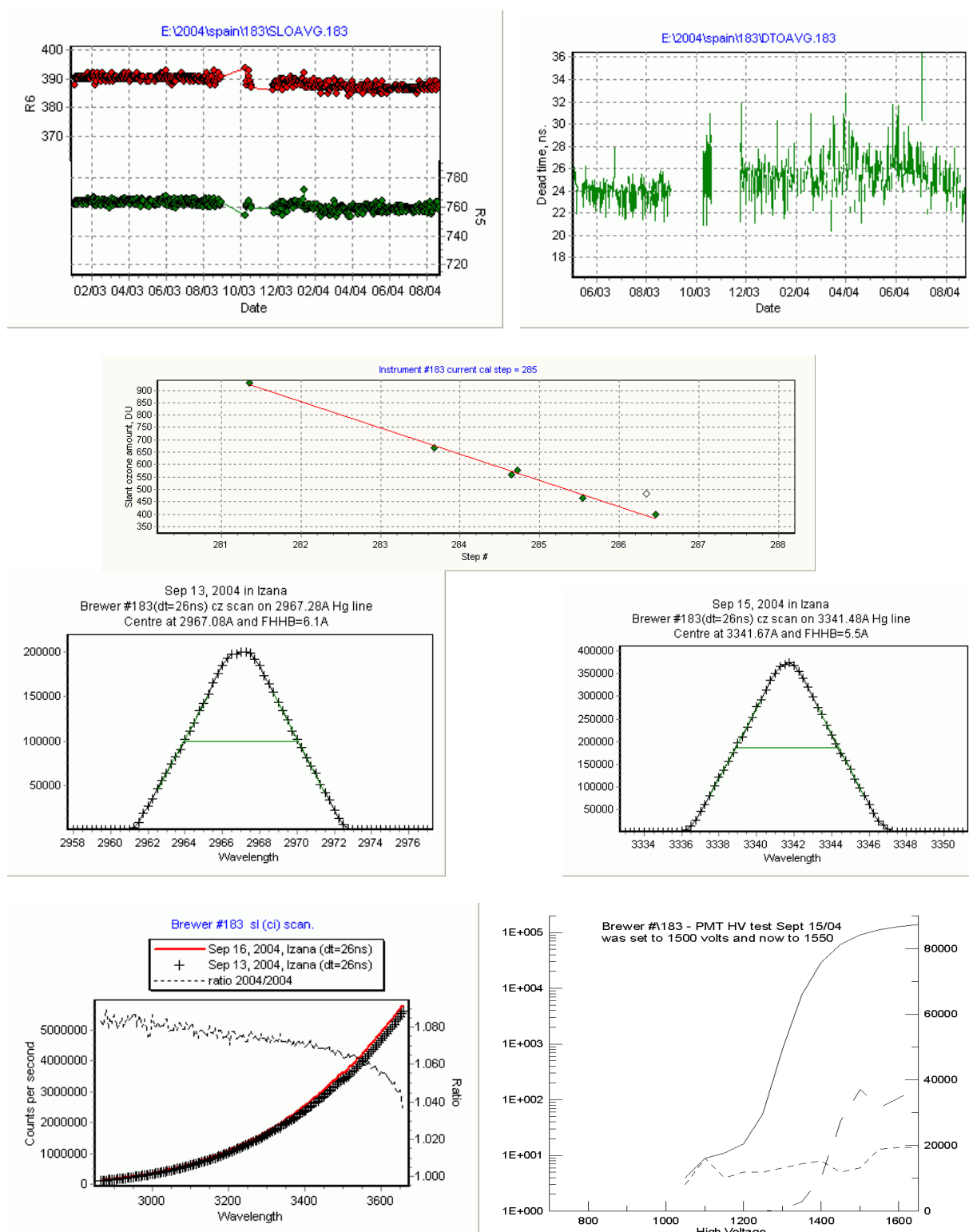
Below are graphs of Brewer #157: the SL ratio R6/F1 for past two years, CI, SC and CZ test results which show good stability and performance.



Below are #033 graphs of SL ratios, CI, DT, CZ, SC, DUV and UV calibration results:



Below are graphs of SL, DT, SC, CZ, CI and HV test results of the new Brewer #183:



After the increase in high voltage (HV) the dead time results went back to 26ns and the sensitivity increased from 8 to 4% (CI graph). The HV setting on recent Brewers has been in the range of 1000-1300 volts. It is the opinion of IOS that the instability is probably due to high voltage or PMT quality.

VII. Final Ozone results and ETC Analysis - Sept. 2004 – from IOS Bfilepro.exe program

Day	O3	dev	#/tot	mu	#/tot	SO2std	coeff	S2ETC	dev	O3std	coeff	O3ETC	dev
#157 AM													
257	282.4	+1.4	41/ 54	150	14/16	7.5	0.8400	200	+23	1.8	0.9998	1594	+5
258	280.7	+0.9	76/104	152	35/41	5.0	0.9695	156	+5	1.4	1.0000	1574	+1
259	289.1	+1.3	85/100	153	39/44	6.7	0.9712	216	+6	2.1	0.9999	1590	+2
261	296.5	+1.2	56/ 66	146	31/33	5.5	0.9824	212	+5	2.2	1.0000	1593	+2
#157 PM													
257	282.4	+1.4			25/25	9.4	0.9111	170	+11	2.9	0.9999	1574	+3
258	280.7	+0.9			34/35	7.6	0.9506	200	+8	2.8	0.9999	1584	+3
259	289.1	+1.3			40/41	9.7	0.9226	191	+9	2.9	0.9999	1581	+3
261	296.5	+1.2			21/23	8.5	0.9570	261	+12	2.4	0.9999	1605	+3
#017 AM													
257	284.6	+2.3	50/ 85	151	13/15	4.4	0.9999	3289	+10	2.0	1.0000	3318	+5
258	281.1	+1.2	101/117	150	53/58	8.0	0.9998	3307	+6	1.8	1.0000	3329	+1
259	289.2	+1.5	102/120	149	51/56	7.3	0.9998	3354	+6	2.4	1.0000	3334	+2
260	302.4	+1.2	99/116	147	52/56	7.1	0.9998	3366	+6	2.5	1.0000	3343	+2
261	296.4	+1.4	89/ 99	139	44/48	8.1	0.9998	3347	+7	2.6	1.0000	3341	+2
#017 PM													
257	284.6	+2.3			32/35	7.8	0.9997	3239	+10	2.8	1.0000	3311	+4
258	281.1	+1.2			43/43	10.3	0.9997	3285	+9	3.8	1.0000	3321	+3
259	289.2	+1.5			43/46	11.2	0.9995	3224	+11	3.7	0.9999	3303	+4
260	302.4	+1.2			36/43	8.9	0.9998	3349	+8	2.4	1.0000	3344	+2
261	296.4	+1.4			38/41	8.2	0.9996	3342	+11	3.1	0.9999	3350	+4
Excluding day 257 the ETC Means= 3333/3322													
#183 AM													
257	282.6	+2.6	52/ 74	150	21/22	5.9	0.9828	337	+10	3.1	0.9998	1633	+5
260	303.6	+1.4	57/ 91	156	27/29	6.8	0.9831	319	+8	3.8	0.9998	1639	+5
261	297.4	+1.2	39/ 63	164	19/21	8.6	0.9815	349	+11	2.6	0.9999	1643	+3
#183 PM													
257	282.6	+2.6			27/30	10.7	0.9572	300	+12	2.9	0.9999	1639	+3
260	303.6	+1.4			24/28	7.2	0.9768	382	+12	1.7	0.9999	1663	+3
261	297.4	+1.2			17/18	6.9	0.9881	395	+11	3.0	0.9999	1658	+5
#033 AM													
257	282.5	+2.9	41/ 70	155	12/14	13.2	0.9990	3637	+33	2.0	1.0000	3397	+5
258	280.6	+1.0	96/121	150	51/54	18.2	0.9992	3538	+14	2.8	1.0000	3385	+2
259	289.5	+1.7	85/110	150	35/40	13.6	0.9996	3678	+12	2.0	1.0000	3415	+2
260	302.1	+1.5	87/106	138	54/57	11.9	0.9997	3670	+9	2.6	1.0000	3413	+2
261	296.5	+1.6	83/ 98	145	40/44	12.6	0.9996	3670	+11	2.4	1.0000	3414	+2
#033 PM													
257	282.5	+2.9			24/27	23.1	0.9983	3623	+30	5.2	0.9999	3396	+7
258	280.6	+1.0			38/42	13.6	0.9996	3583	+12	2.5	1.0000	3387	+2
259	289.5	+1.7			45/45	20.0	0.9990	3604	+17	4.4	0.9999	3390	+4
261	296.5	+1.6			35/39	16.1	0.9993	3619	+16	3.4	1.0000	3410	+3
Summary													
					#017	#157	#033	#183					
ETC's recommended O3/SO2					3335/3300	1584/210	3390/3575	1650/370					
Langley ETC's from above					3333/3322	1587/238	3400/3625	1646/337					
Difference					-2 / 22	3 / 28	10 / 50	-4 / -33					