

Calibration Report on Brewers #033, #157, #183, #185 - Izaña, Spain - October 6-11, 2006

I. Introduction and Instrument Status:

International Ozone Services Inc. (IOS) with the help of AFC Ingenieros, S.A. completed the ozone and UV calibration and service of four INM Brewer instruments at Izaña. Traveling standard instrument #017 along with #185 and #157 were used here as the main calibration references.

The MKIII Brewers #157 and #185 have operated very well in the past year. Standard Lamp (SL) ratios R6/R5 have not changed and the ozone results were in good agreement.

Brewer #033, a MKII instrument normally operated at sea level in Santa Cruz was re-located here for this calibration. It worked well after reworking heat sink HV converter and its SL ratios had increased as shown below. The ozone results were quite good with the SL corrections to ETC constants.

Brewer #183 was working fairly well but was 2% higher in ozone. It had suffered more severe shocks late last year during a storm and was out of service for some months. The ozone results from #183 were quite good with SL corrections to ETC constants.

II. Summary of results and changes:

Instrument	#033	#157	#183	#185
SL ratios 2006	2125 / 3940	338 / 580	322/562 – 400/705	310 / 442
SL ratios change from 2005	-17 / -93	n/c	-44/-141 -> 35 / 0	n/c
ETC constants 2006 (chg?)	3440 / 3620 (0/-30)	1605 / 243 (n/c)	1700 / 430 (60/95)	1574 / 80 (n/c)
ETC constants last cal 2005	3440 / 3650	1605 / 243	1640 / 335	1574 / 80
Cal step (old / new)	919 / 919	1026 / 1026	284 / 284 ->1021	284 / 284
Absorption Coeff's (change)	.3365/1.1362	.3397/1.15	.3405/1.146 (chg)	.3422/1.1445 (*)
ICF file recommended	icf27906.033	icf26305.157	icf27906->icf28306	icf25905.185
DCF file recommended	dcf27900.033	dcf28106.157	dcf28106.183	dcf28106.185
DT present/last/setting	39 / 39 /40	28 / 29 / 32	24 / 26 / 26	30 / 31 / 33
GS const. (change?)	n/a	.998, -10 (n/c)	.9928/8 (n/c)	.995 / 2.5 (n/c)
CI scan on SL to 2005 scan	+4%	-3 to -2%	-9 to -11%	-7% flat
CZ on 2967 / 3341 Hg lines	n/c	ok, .63nm/.57nm	ok, .62nm / .55nm	ok, .63nm/.56nm
Repairs or adjustments	HV conv.	n/c	zenith, mic const	n/c
New UV resp - INM lamps	uvr28406.033	uvr28306.157	uvr28406.183	uvr28306.185

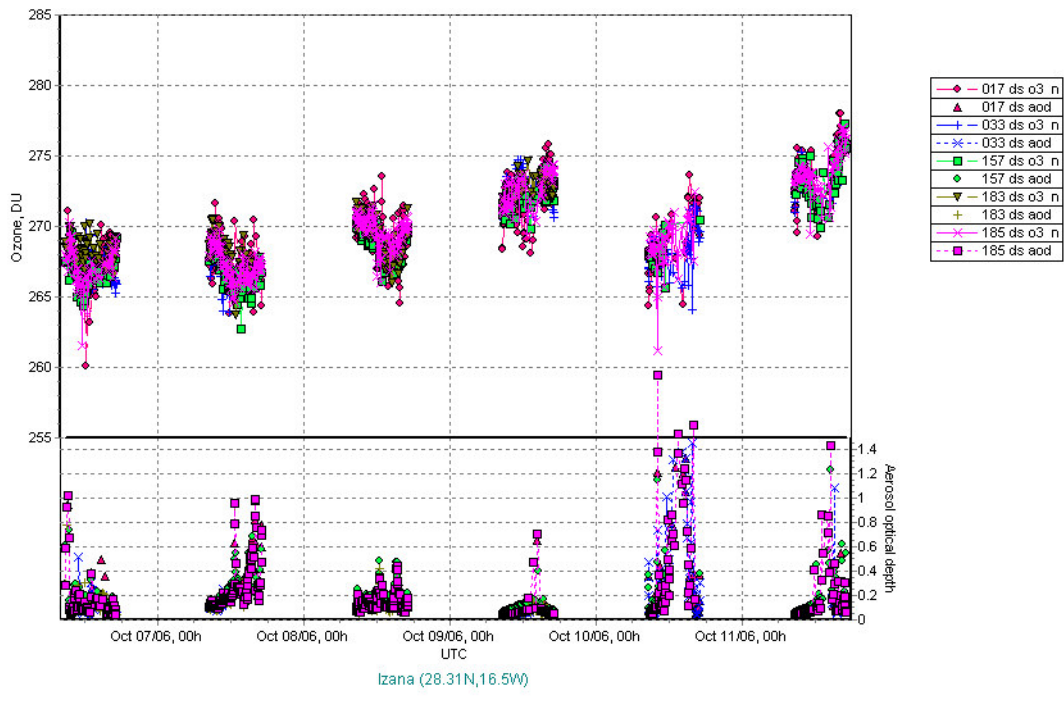
III. Final ETC constants and Ozone Test Results:

The weather co-operated quite well for the 6 days and many direct sun observations (up to 100/day) as well as many simultaneous UV scans were collected. Much time was spent on #183 to change the configuration file to allow the use of 2967 line for Hg tests. New absorption coefficients recommended last year were not in use in real time and dispersion testing showed once again that they were proper. Data from the next 6 days after this period were analyzed to confirm the final constants for #183, which had shifted on the second last day. This change was assumed to be due to humidity input when instrument was opened.

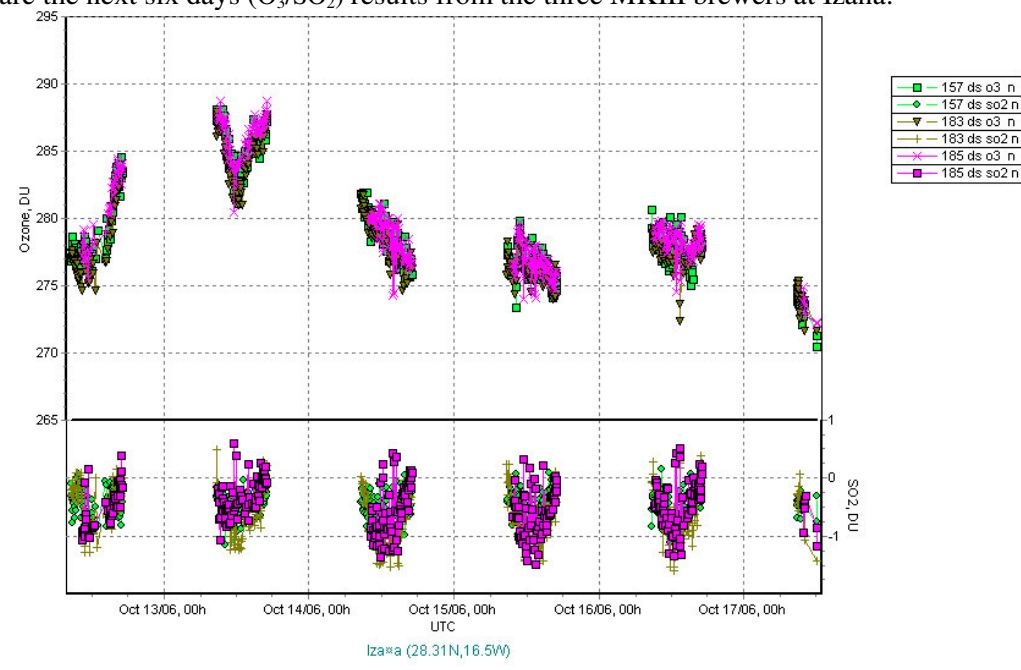
#185 has shown excellent stability based on its SL ratios and the 2005 ETC constants of 1574/80 were found to be good. The absorption coefficients recommended last year were not in use and it was agreed that the user values (*0.3422/1.1445) were best. This decision is supported by recent dispersion results and the ozone agreement to #157 and #017 this year was best with these coefficients. The measurements using neutral density (n.d.) filter #4 were not as noticeable this year since the software is set to alternate filters if oscillation mode is encountered. The ozone measurements on filter #4 generally have higher standard deviation. This filter or #3 or all should be replaced to reduce filter oscillation periods when doing DS measurements.

The traveling standard #017 had its photomultiplier tube replaced again in late August. The SL ratios were 2190/3900 and the ETC constants were set at values of 3410/3470 and with the 2005 absorption coefficients 0.338/1.13.

Below are the final ozone results of the ozone comparison data collected, using the recommended constants listed on page 1. Note the good agreement in ozone levels and aerosol optical depth (AOD) results. The AOD was quite variable this year.

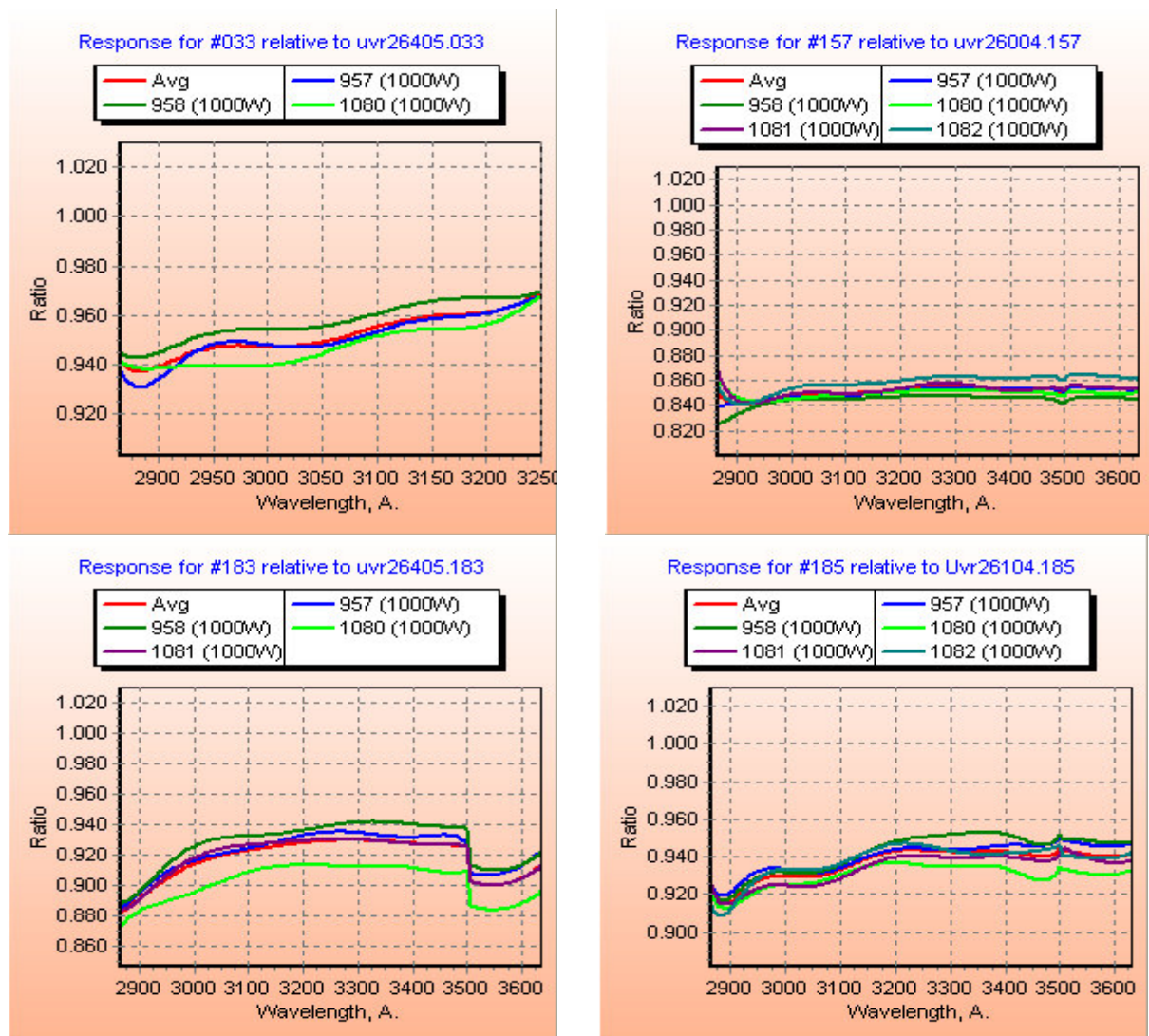


Below are the next six days (O_3/SO_2) results from the three MKIII brewers at Izaña:



IV. UV calibration results:

Four local 1000w lamps (957, 958, 1080, 1081) were used this year for most UV calibrations and the new response results were calculated and compared to previous response files. The new response files for #033 and #183 was ~5% lower than 2005 results. The new files for #157 and #185 were ~15% and ~6% lower respectively than 2004 results, as shown on next page.



Dispersion tests (dsp) were completed on each instrument using the internal mercury and an external cadmium spectral lamps to check the wavelength accuracy for UV scanning, ozone operating wavelengths, absorption coefficients and slit functions. The new dispersion constants results (files dcf28106.###) are now recommended for future use on all the MKIII instruments to improve wavelength accuracy especially between 3350-3500Å. This is due to the use of 3499 Cd line now while the factory methods did not. Also the new IOS processing program (dispro.exe) allow analysis with new fitting (cubic) as well. The present software does not allow use of such constants yet but hopefully soon and wavelength accuracy should improve further. No dispersion constants change to #033 was necessary.

V. Servicing and Software changes:

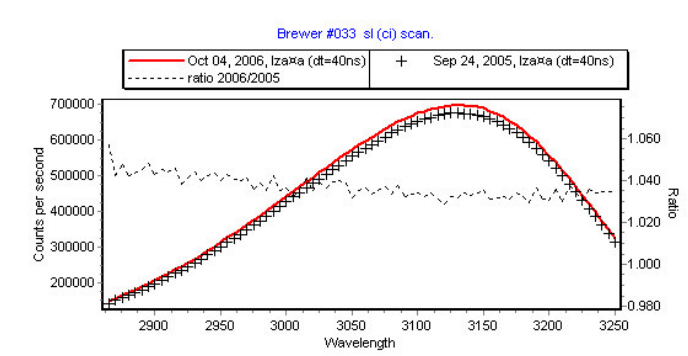
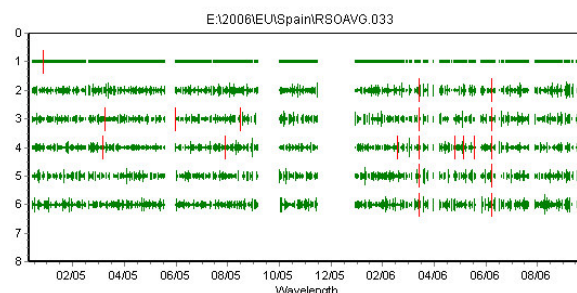
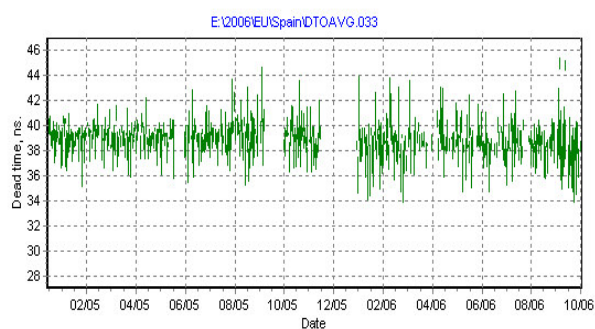
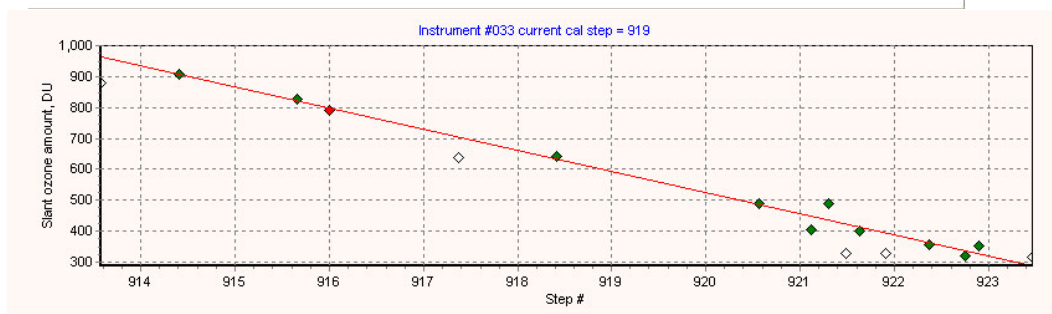
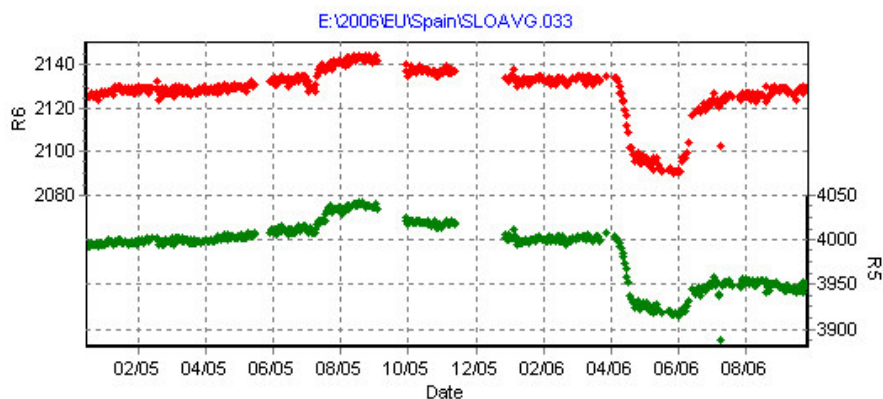
The high voltage on #033 failed completely on the second day and the problem was in heat sink assembly. After loosening the mounting screws on HV converter, it started working again and continued to work fine. The lamp connector was also repaired. Cleaning and lubrication as required was done to micrometer gears and pushrod bearings. Some mounting screws on #183 were tightened and the large zenith gear setting was improved. But during this process the electronics sent the gear to wrong side of sensor and it took much time to get setup again.

The most recent software programs were provided but left running on #183 only. The user had modified versions running on the other instruments. The new software still needs to be reduced in size to operate large routines reliably and IOS hopes to provide this soon.

VI. Izaña Brewers report 2006 Graphs:

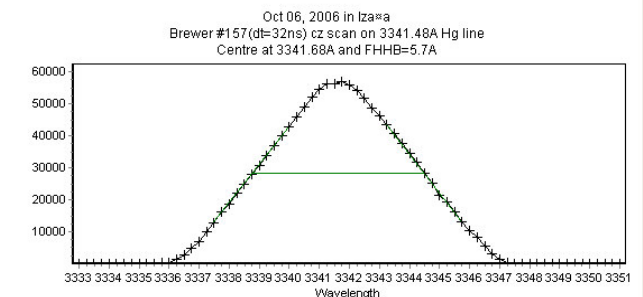
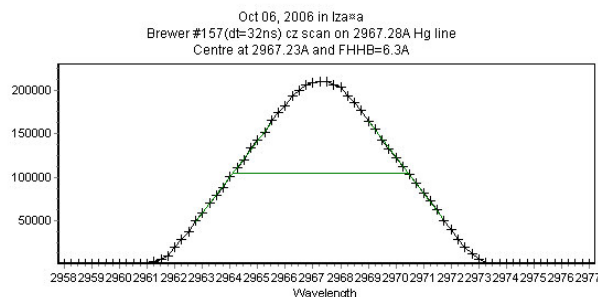
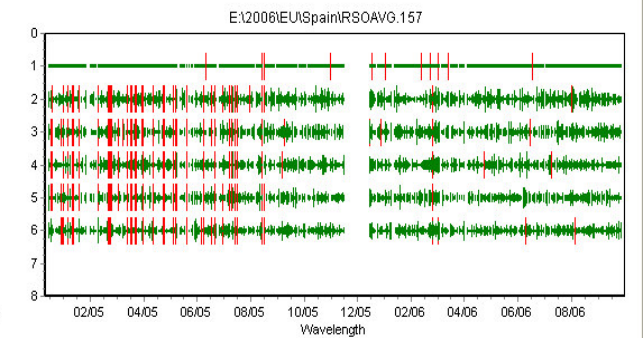
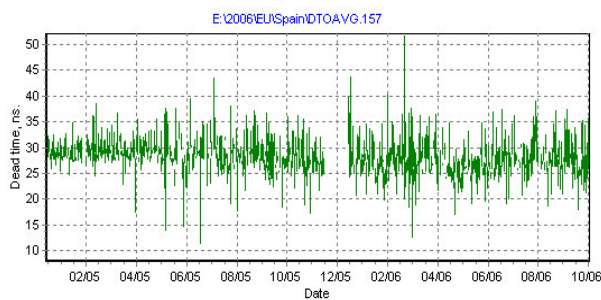
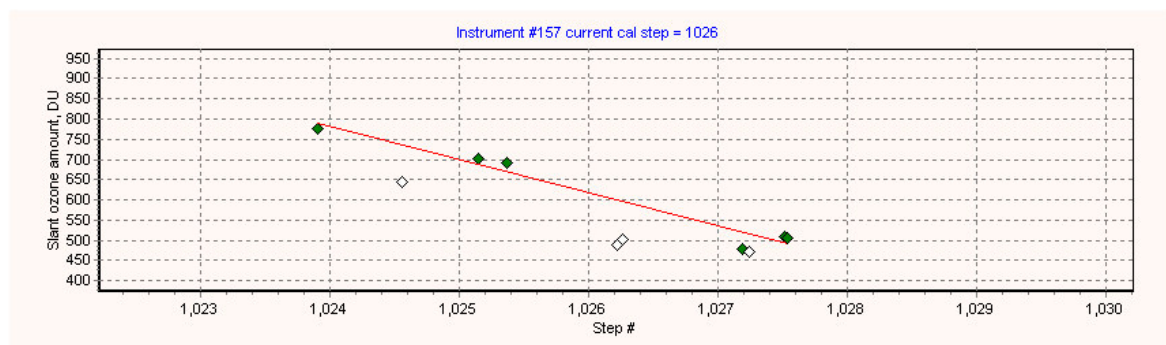
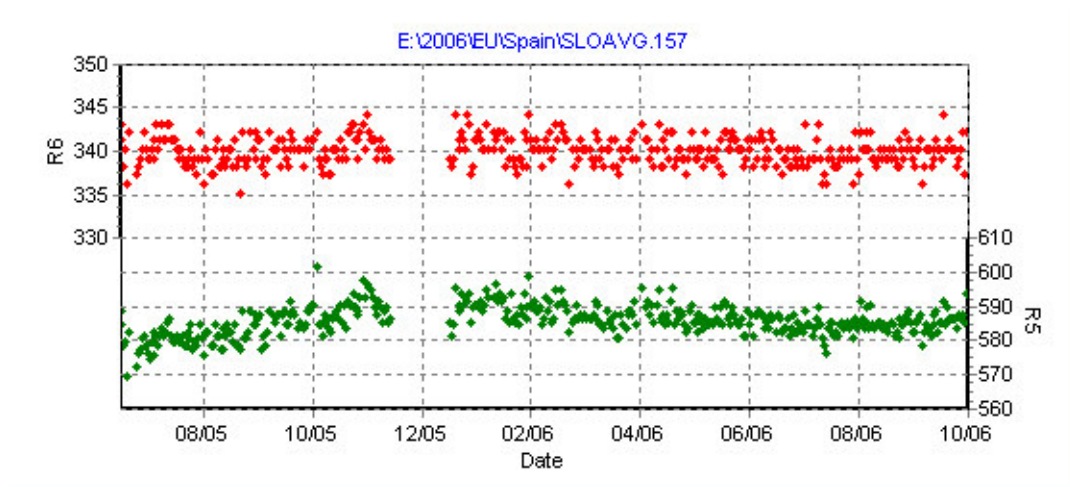
Below are the graphs of SL ratios, SC, DT, RS, CI test results for the MKII Brewer #033:

The reason for the recent instability in the SL ratios is unknown. The instrument is operating very well but the final ETC constants did not follow the SL ratios change which is unusual. The sun scan results show the cal step setting of 919 is still proper. The other tests have remained stable and normal.



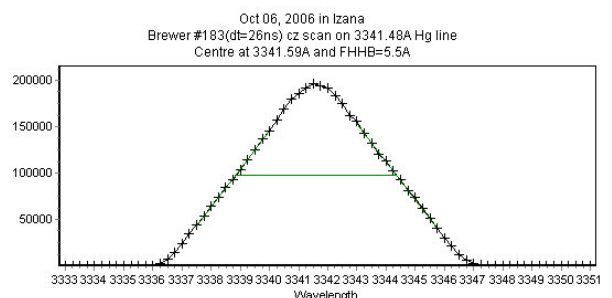
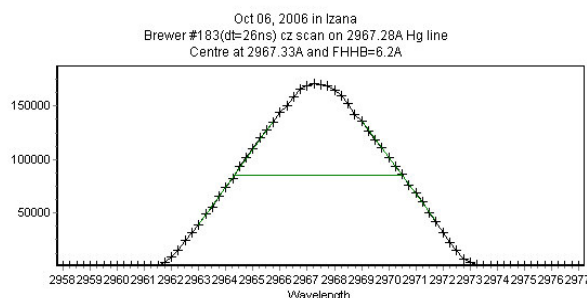
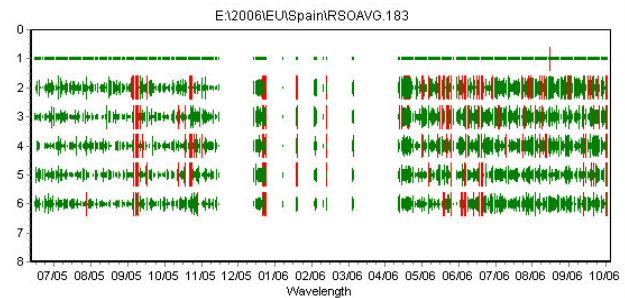
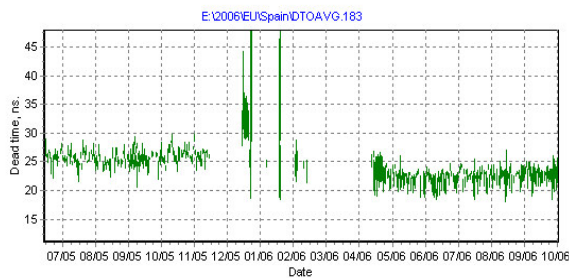
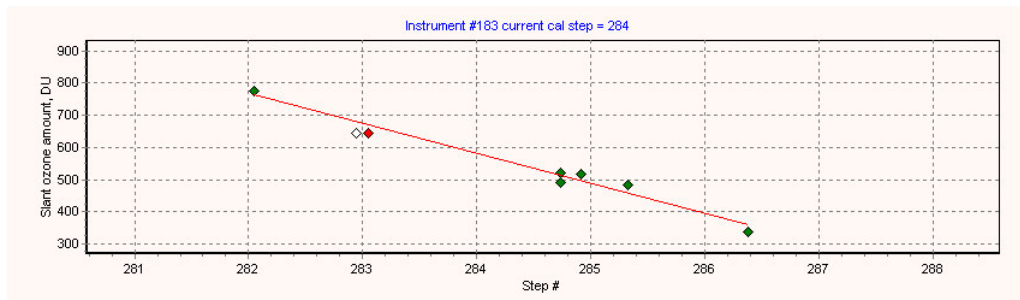
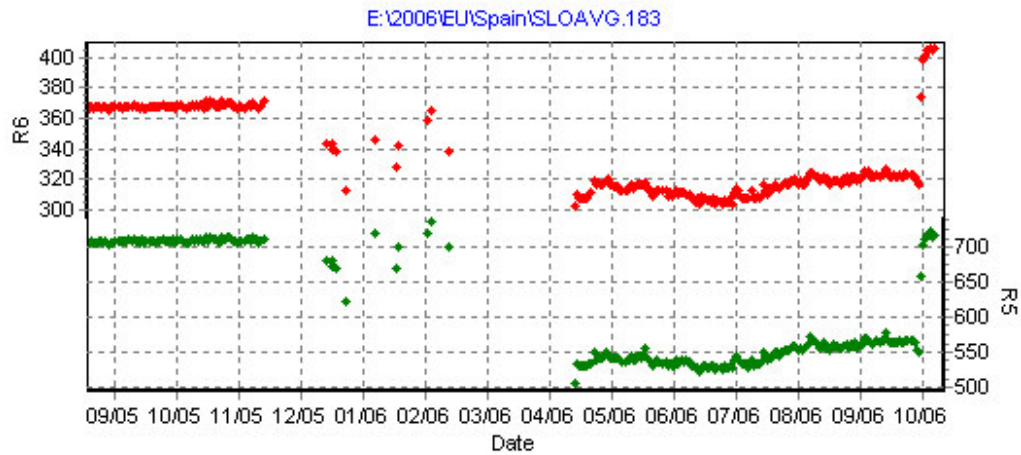
Below are graphs of MKIII Brewer #157 of SL, SC, DT, RS and CZ results.

The sun scan results show cal step 1026 is still the proper position. The other tests have continued to be stable and normal.



Below are graphs of SL, SC, DT, RS, and CZ test results from the MKIII Brewer #183.

Note the shift in SL ratios in the past year and during this calibration period. The sun scan results show cal step 284 was proper and was changed to 1021, the equivalent wavelength position for 2967 line for Hg calibration tests. The other tests are still normal but note the RS tests are slightly noisier than last year.



Below are graphs of SL, SC, DT, RS, and CZ test results from the MKIII Brewer #185:

All show quite good stability or are normal except for bump on left side of CZ 3341 scan as it had last year as well. The instrument was taken to a campaign in Finland in March, 2006.

