

## Calibration Report on Brewers #033, #157, #183, #185 at Izaña – Aug. 26-Sept. 2, 2007

### I. Introduction and Instrument Status:

International Ozone Services Inc. (IOS) completed the ozone and UV calibration and service of four INM Brewer instruments at Izaña. The IOS traveling standard instrument #017 along with local standard #185 and #157 were used as the main calibration references.

All of these Brewers have operated well in the past year. Standard Lamp (SL) ratios R6/R5 had not changed significantly and the ozone results were all in good agreement without any change to 2006 constants. Below is table of results and a graph of all the direct sun ozone/SO<sub>2</sub> results is on the next page. For some half day periods the ozone is stable enough to obtain independent ETC constants. However the Aerosol Optical Depth (AOD) levels were higher than desired.

### II. Summary of results and changes:

Instrument Summary	#033	#157	#183	#185
SL ratios 2007	2130 / 3945	338 / 580	410 / 720	314 / 448
SL change to 2006	5 / -5	n/c	10 / 15	0 / 0
ETC constants 2007	3440 / 3620	1605 / 243	1700 / 430	1574 / 80
ETC constants 2006	3440 / 3620	1605 / 243	1700 / 430	1574 / 80
Cal step (old / new)	919 / 919	1026 / 1026	1021 / 1021	284 / 284
Absorption Coeff's	.3365 / 1.1362	.3397 / 1.15	.3405 / 1.146 (chg)	.3422 / 1.1445
ICF file recommended	icf27906.033	icf26305.157	icf28306.183	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 2006	-40% initially	-3 to -2%	-9 to -11%	-7% flat
CZ on 2967 / 3341 lines	2966.95 / .62nm	ok, .63nm/.57nm	ok, .62nm / .55nm	ok, .63nm/.56nm

### III. Final ETC constants and Ozone Test Results:

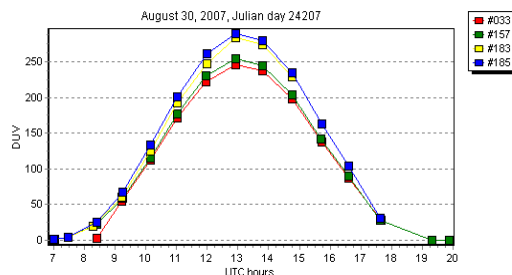
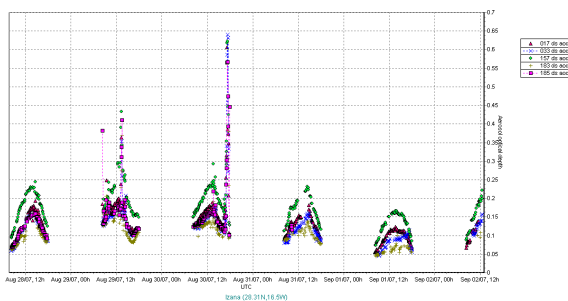
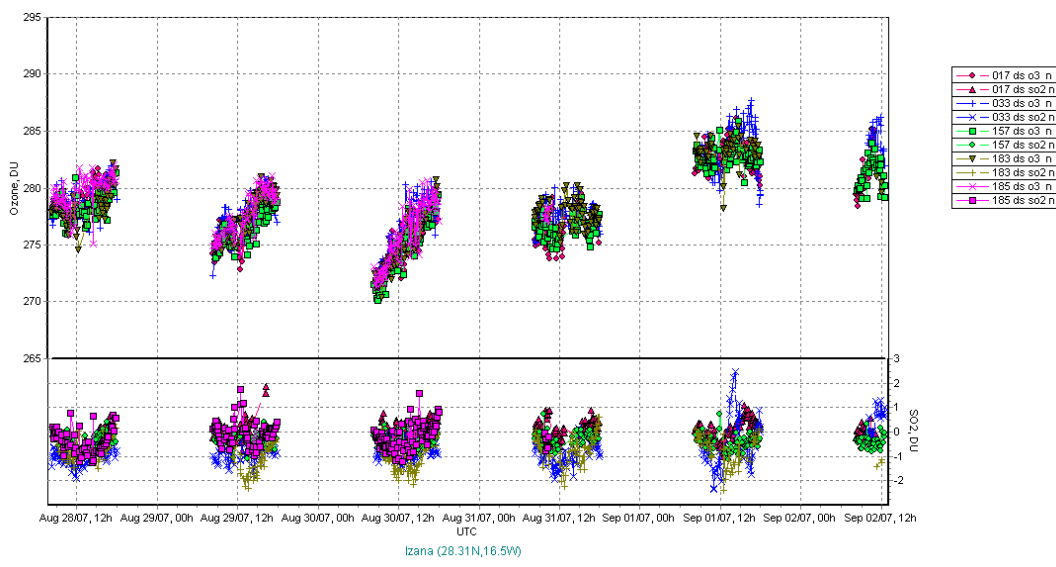
The weather co-operated quite well for the 6 days and many direct sun observations (up to 100/day) as well as many UV scans were collected.

#185 has shown excellent stability based on its SL ratios and using the 2005 ETC constants of 1574/80 was in good agreement with the others. The noisy direct sun measurements using neutral density (n.d.) filter #4 have continued and a method of adjusting ETC constant when this filter is selected looked very promising to improve the results. This filter should be replaced with one with proper attenuation value that fits with the other filters. #183 has same problem as well as value of #157 filter but it rarely gets selected.

The user advised that #183 has had variability in tracking results at various times. Strange zenith motor operation was experienced with #183 when it was re-started after servicing, e.g. not stopping at hard stop and damaging the drive gears. This situation has been experienced with zenith and azimuth on other systems with new electronics configurations. It seems on startup that motors need to be in same position as before they were turned off. The 2006 recommended absorption coefficients for #183 were not in use in real time and the dispersion test results showed once again that these values are proper.

The traveling standard #017 was and has been working well. The SL ratios were stable at values of 2155/3840 and the ETC constants were initially set at values of 3355/3350. After evaluation of initial data it was decided that if the Dead Time (DT) constant was increased from 32 to 37ns then the direct sun results were less noisy. With high counting levels the DT results measure at 37ns. The ETC constants then had to be adjusted up to 3375/3385 to obtain previous ozone levels.

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



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 dcf ?####) are now recommended for future use on all the MKIII instruments to improve wavelength accuracy especially between 3350-3500A. Also the recently improved IOS processing program (dispro.exe) produced more accurate constant. No dispersion constants change to #033 was necessary.

## V. Servicing and Software changes:

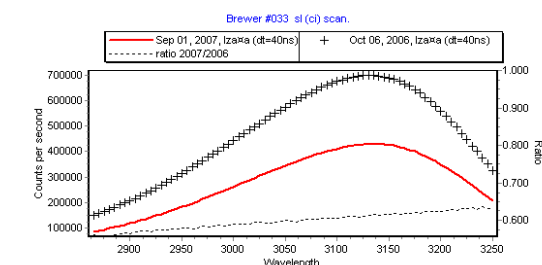
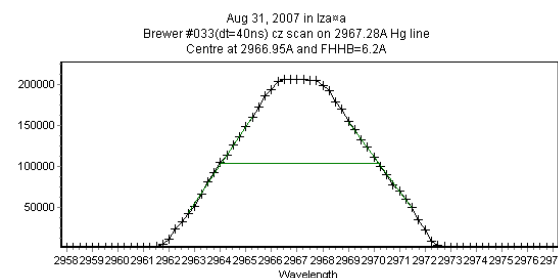
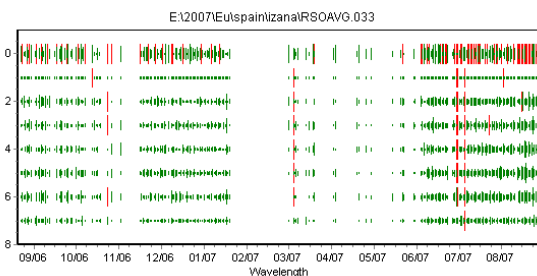
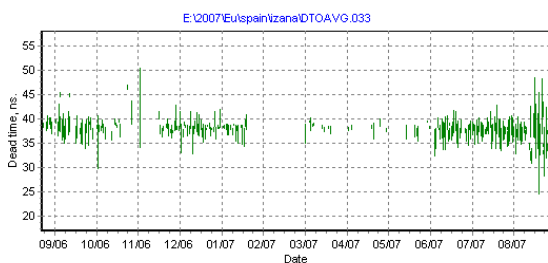
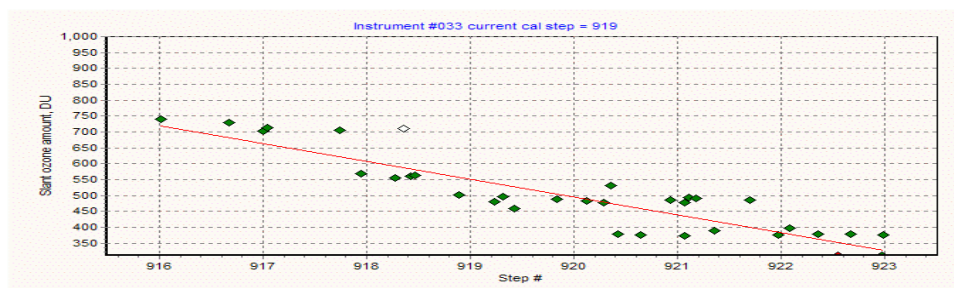
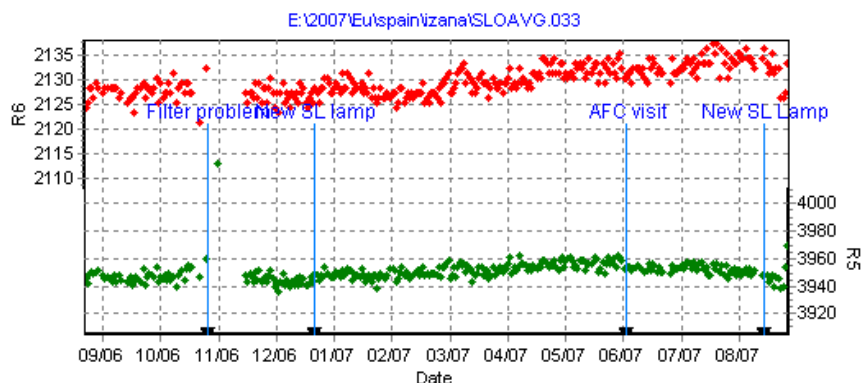
Cleaning and lubrication as required was done to micrometer gears and pushrod bearings. On #183 the middle zenith gear damaged itself after servicing. A proper standard lamp was installed and aligned in #033.

The most recent control software (V376b) programs are available and recommended for future use. The problem of out of memory errors should be reduced with bug fixes and especially routines like RE, HG, HP that are smaller in size. IOS still feels that tracking errors can be produced from the use of the FV and ZE commands on instruments with new electronics. Further testing needs to be done.

## VI. Izaña Brewers report 2007 Graphs:

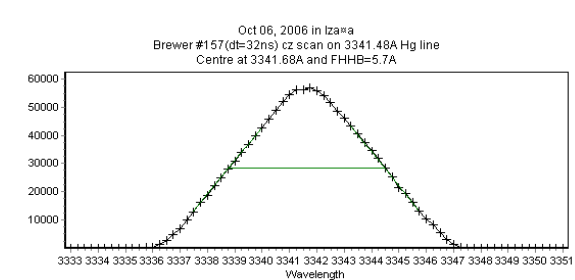
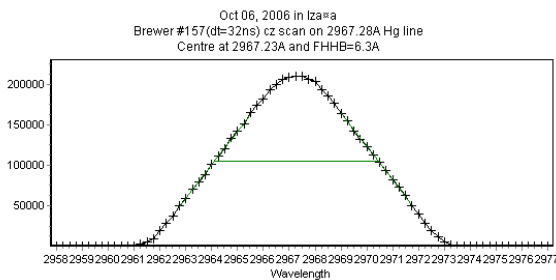
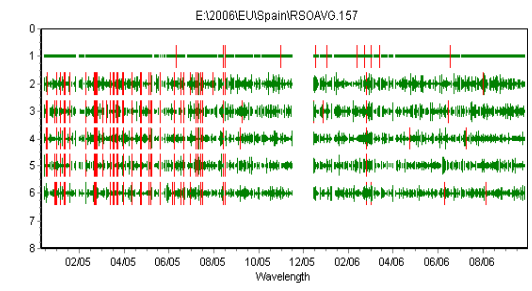
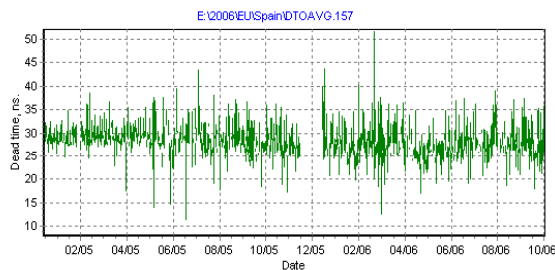
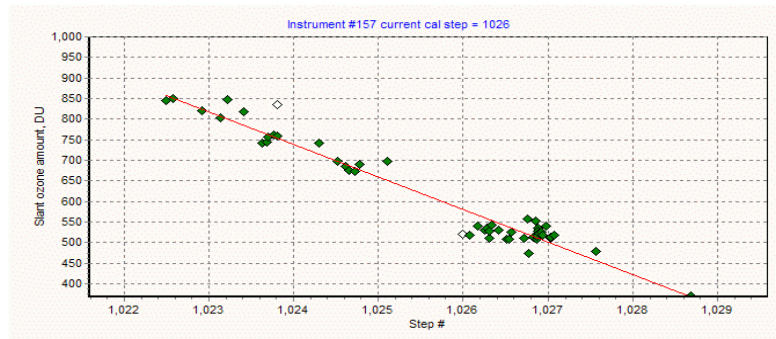
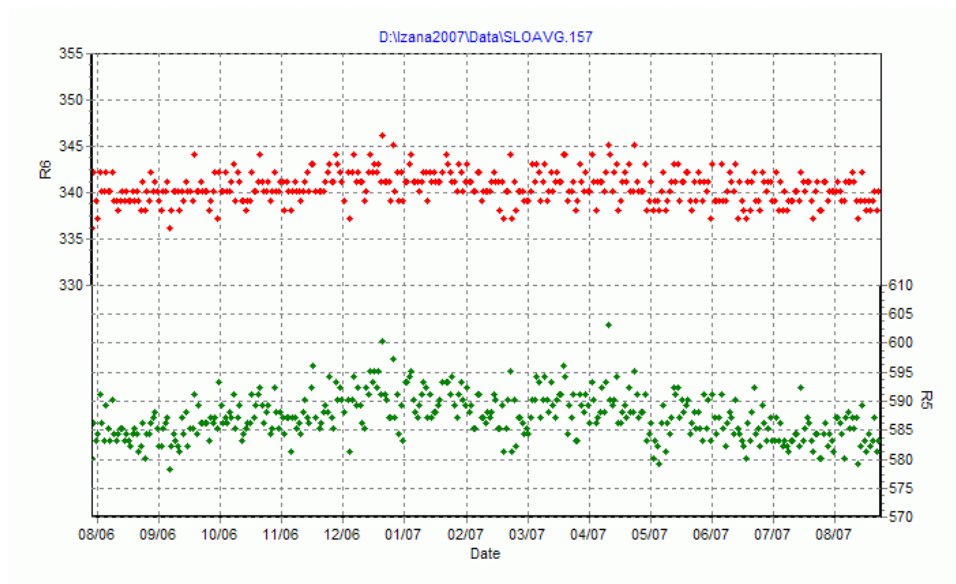
Below are the graphs of SL ratios, SC, DT, RS, CI test results for the MKII Brewer #033:

The reason for the recent instability in the SL ratios was found to be due to type of replacement lamp that had a vertical filament. It could not be aligned properly. The last graph shows final and previous SL CI scans, note higher intensity level now. The sun scan results show the cal step setting of 919 is still proper.



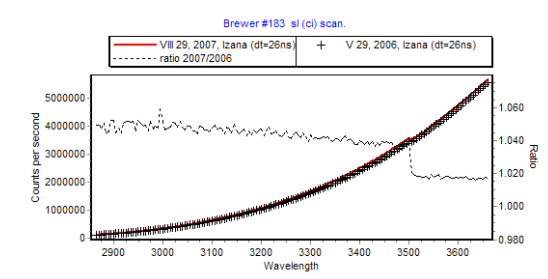
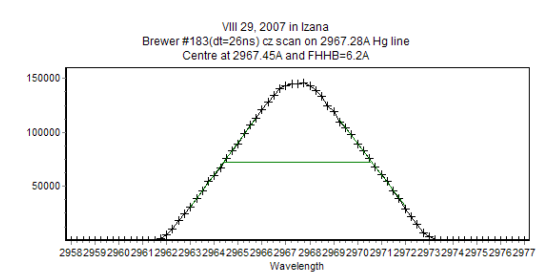
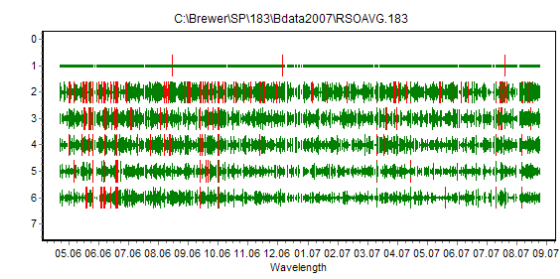
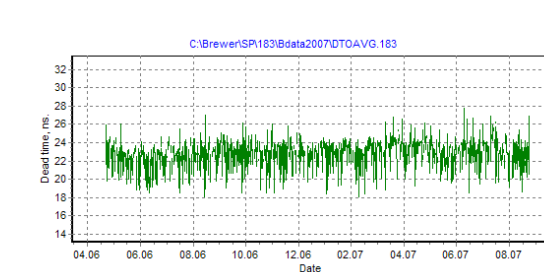
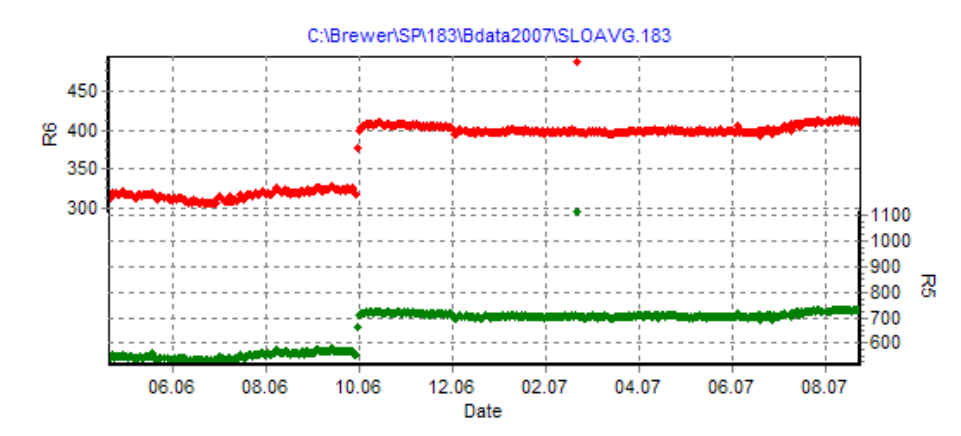
Below are graphs of MKIII Brewer #157 of SL, SC, DT, RS and CZ results:

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 stable SL ratios since 2006 calibration. The sun scan results show cal step 1021 is still the proper setting for Hg calibration tests. The other test results are still normal.



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

All test results show quite good stability. The instrument was once taken to a campaign in Finland this past winter. The sun scan results show cal step 284 is still the proper setting for Hg calibration tests.

