

Procedure for checking and adjusting the zenith prism alignment of a Mk IV Brewer spectrophotometer

**National Ultra Violet Monitoring Center
Department of Physics and Astronomy
University of Georgia
Athens, GA 30602**



**Document 9
Revision A**

**Prepared by Dr M.G. Kimlin and T.E. Taylor
Last updated October 15, 2002**



Introduction

The zenith prism in a MkIV Brewer spectrophotometer is fixed to a shaft which rotates via a gear assembly driven by a stepper motor. Mounted to the main drive gear is a thin metal tab, which passes through an optical sensor, designating the zero position of the assembly. A proper alignment is when the zenith prism is focused on the internal lamp at the same time as the tab is centered in the diode sensor.

It is possible for the zenith prism to become misaligned on its shaft due to communication failures that may occur between the Brewer and the computer, especially during power outages. A zenith prism misalignment is observable as a step decrease on the order of 10 to 50% in the measured standard lamp intensity as well as in the measured 50W lamp output.

Due to the way in which the zenith prism mechanism was engineered it is difficult to move the zenith prism back to the precise position at which it was set before the misalignment occurred. Since the Brewer's spectral responsivity is extremely sensitive to the zenith prism position, any change to the prism position will compromise the spectral response calibration of the instrument. In an ideal situation, an initial and final calibration should be performed using the NUVMC standard 1000W lamp calibration technique. Oftentimes a calibration using the 50W field lamps will have to suffice.

Equipment

Mk IV Brewer spectrophotometer
Hex wrench set (English sizes)
Coat or towel to cover head on sunny day

Purpose

This Standard Operating Procedure (SOP) outlines the NUVMC technique for checking the alignment of a MkIV Brewer zenith prism and correcting the alignment if necessary.

Procedure

1. If the Brewer is still running in schedule exit the schedule by pressing the Home key when the message "Press Home to abort schedule" appears on the computer screen.
2. At the Brewer command line give the command "ZE" to rotate the zenith prism to the zero position.

3. At the Brewer command line give the command "B2" to turn on the standard lamp.
4. Look into the iris view port on top of the Brewer case. Refer to Figure 1: Brewer View port Locations (from page 3 of the Brewer Operators Manual OM-BA-C231 REV B, August 15, 1999). An image of the standard lamp should be present on the image of the iris. The lamp image is oblong and about one centimeter in width. The long axis of the lamp image is oriented along the long axis of the Brewer case. If the lamp image is centered on the iris within half the width of the lamp image then the alignment is considered to be good and no further action needs to be taken. Proceed to step 25. If the image is off centered by more than half the width of the lamp image then the prism alignment is off centered and requires an adjustment.
5. If you are not confident in the accuracy of the present alignment and you would like to see how the alignment of the image on the iris changes with a change to the position of the zenith drive gear, the zenith prism can be rotated manually. Place fingers on the 2 inch diameter brass drive gear which is mounted to the zenith prism assembly and rotate the gear in the clock wise direction. Rotation of the brass drive gear in the clock wise direction will correspond to a counter clock wise rotation of the $2 \frac{3}{4}$ inch main zenith prism drive gear. The main drive gear is the one mounted directly to the zenith prism shaft. It has a tab which moves into the optical switch when the zenith drive is in the zero position. Be careful not to rotate the brass drive gear too far in the counter clock wise direction as eventually the zenith prism will reach its hard stop and then the drive gear may slip with respect to the zenith prism shaft on which it is mounted. Slippage of the main drive gear on the zenith prism shaft is what causes zenith prism misalignment.
6. As the zenith drive is rotated manually by hand the image of the lamp should be observed to move back and forth across the iris along the short axis of the Brewer when viewed through the iris view port. Once the zenith drive has been moved by hand give the ZE command in order to rezero the drive with the optical switch. You should be able to confidently determine if the image of the lamp is in fact oriented on the center of the iris when the tab is in the sensor after performing the ZE. If there has recently been a noticeable step decrease in the SL and 50W lamp results and the lamp image is off center by more than about half the width of the lamp image it may be necessary to perform a zenith prism realignment.
7. If the zenith prism alignment is off by a large degree the lamp image may not appear at all. Visual inspection of the zenith prism should indicate that

- it is pointing down toward the internal lamp. Use steps 5 and 6 to manually search for the image moving across the iris. If the test is being performed outdoors on a bright, sunny day, the image may be hard to see. A coat or similar item over the head to block the direct beams of the sun will help.
8. Once a decision has been made concerning the accuracy of the alignment, give the command "B0" to turn off the standard lamp.
 9. Before making adjustments to the zenith prism, perform either a 1000W lamp spectral response calibration or a bi-weekly 50W lamp calibration on two or three lamps per the procedure given in the most current edition of the NUVMC SOP for operating the Brewer. If the zenith prism alignment is uncertain it may be better to not make any adjustments unless an initial and final spectral response calibration can be performed.
 10. After performing the spectral response calibration or the 50W scans, give the command "PNSL" at the Brewer Home screen command line to turn on the printer and perform a standard lamp check. This diagnostic check monitors the intensity of the internal lamp and will help to document any change in the Brewer sensitivity due to a zenith prism realignment.
 11. Give the command "ZE" at the Home screen command line to zero the prism.
 12. Give the command "B2" at the Home screen command line to turn on the internal lamp.
 13. Place a protective cover on the quartz dome on the top of the Brewer outer cover.
 14. Remove the Brewer outer cover by loosening the four latches and lifting the cover up. Never remove the cover during inclement weather and try to pick the driest, wind free day possible.
 15. Locate the zenith prism assembly directly under the quartz window. Refer to Figure 2 below for a schematic (Figure 2-3 "Spectrometer Targets for Various Zenith Angles" from page 6 of the Brewer Operators Manual OM-BA-C231 REV B, August 15, 1999).
 16. Locate the zenith prism clamp on the very end of the zenith prism shaft. This clamp secures the gear to the shaft so that they rotate in unison.

17. Loosen the 7/64" hex bolt that secures the clamp to the shaft. The zenith shaft will now be free to rotate.
18. Manually rotate the shaft to the position such that the lamp image is centered on the iris image.
19. Tighten the 7/64" clamp bolt to resecure the shaft to the gear, being sure that the image of the lamp remains centered on the iris as viewed through the iris view port. Be sure to torque the clamp down very firmly. If the clamp is pulled out slightly from the end of the shaft before tightening, there will be greater pressure between the clamp and shaft, which will reduce the chance that the gear is able to rotate on the shaft. This precaution will help prevent zenith prism misalignments from occurring.
20. Repeat steps 2 through 4 of the procedure to recheck the alignment of the zenith prism.
21. If the lamp image is still not properly aligned, repeat steps 17 through 19 to adjust it again. If the alignment has been successfully corrected proceed to step 22.
22. Replace the Brewer outer cover and secure the four latches, ensuring that the outer cover is mounted evenly all the way around the Brewer case. Remove the quartz dome protector.
23. At the Brewer Home screen command line give the command "PNSL" to turn on the printer and perform a standard lamp check. Compare the results with those from the initial SL test to document any change in the Brewer sensitivity due to a zenith prism realignment.
24. Run a final set of 50W lamp calibrations using the same lamps as before the zenith prism adjustment was made. Alternatively, perform a final spectral response calibration using the 1000W lamps.
25. Perform a tracker steps per revolution (SR) test followed by a sun sighting (SI) per the procedure in the Operators SOP. This will ensure that the Brewer optical path is reoriented properly if the zenith prism was realigned. The date and time on the computer should be verified to be correct for this step.
26. Enter an electronic comment (CM or CO command) describing briefly if the zenith prism was adjusted or and any other observations made. Also enter a brief entry in the paper station log form.

27. Place the Brewer back into schedule by giving the command "skc" at the command line. When prompted for schedule, enter the name of the current network schedule (epa96d for the US EPA/UGA network as of September 2002).

Figure 1: Brewer Viewport Locations

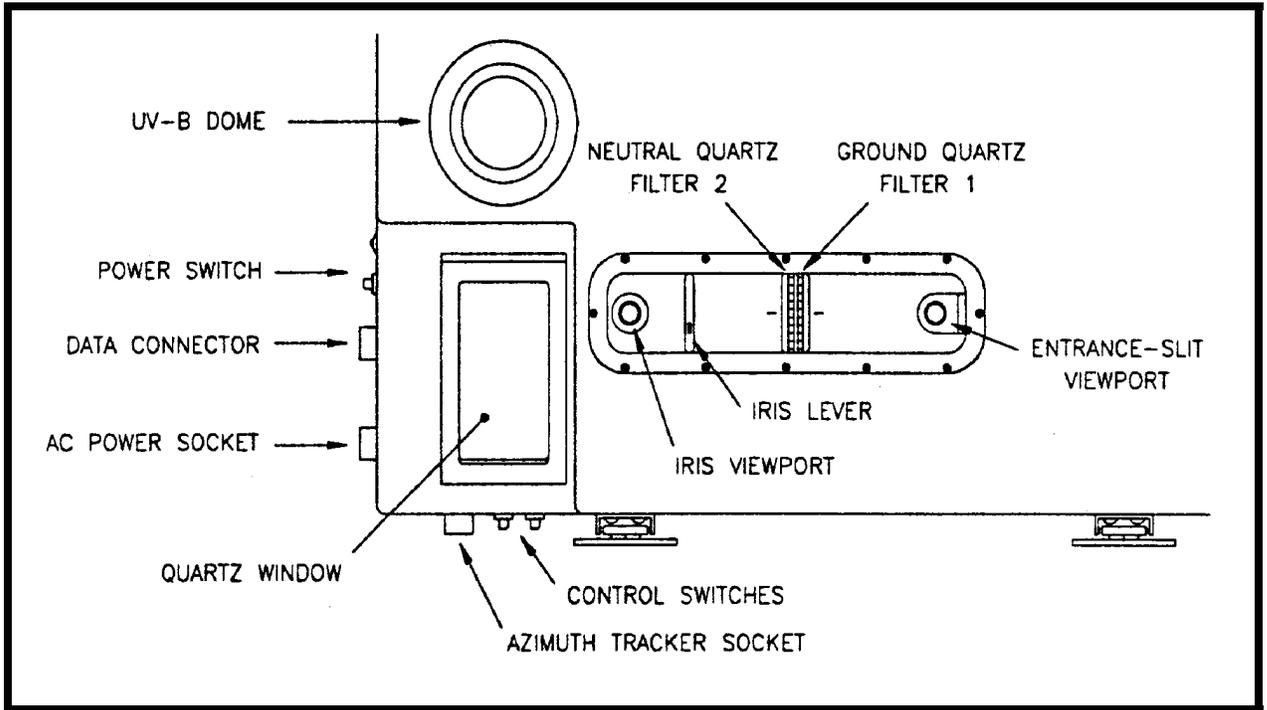
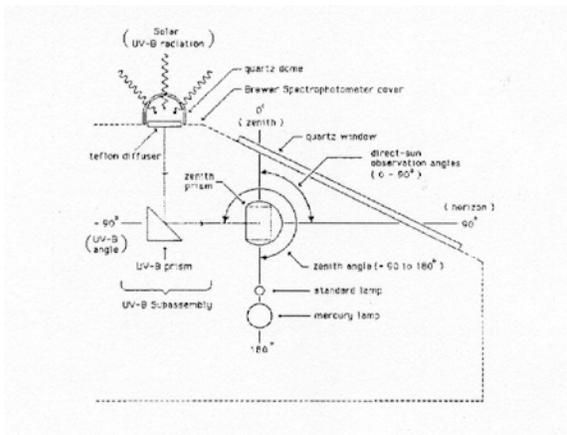


Figure 2: Spectrometer Targets for Various Zenith Angles



**For further information or advice concerning this SOP
please contact the NUVMC at the University of
Georgia at <http://oz.physast.uga.edu>**