

Procedure for checking and replacing the internal mercury bulb in a Mk IV Brewer spectrophotometer

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



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**Prepared by Dr M.G. Kimlin and T.E. Taylor
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Introduction

The Mk IV Brewer spectrophotometer is equipped with an internal mercury (HG) bulb powered by circuitry within the instrument. The HG bulb is used on a daily basis to verify the wavelength calibration of the spectrometer. Over time the bulb filament ages and mercury is deposited on the quartz envelope, leading to a decrease in the output of the bulb. As long as the output of the bulb remains stable over the time period of an HG scan (approximately three minutes), the bulb can continued to be used even when the peak counts fall to around 10,000. However the NUVMC normally replaces bulbs during annual site visits if the peak counts have fallen under 100,000 and are still dropping. On occasion the bulb filament may break, at which time it should be replaced by the operator before further atmospheric data is collected with the Brewer.

Equipment

Brewer Mk IV spectrophotometer (multiple electronic boards)
Replacement HG bulb
Cleaning alcohol
Kimwipes or tissue

Purpose

This Standard Operating Procedure (SOP) outlines the NUVMC technique for checking the condition of the internal HG bulb and replacing the bulb if necessary in a Mk IV Brewer spectrophotometer with multiple electronic boards.

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" message appears on the computer screen. The Brewer may already be at the Home screen if the HG bulb has failed because it will not be able to remain in automated schedule containing an HG routine.
2. For the next few steps leave the power to the Brewer in the on position.
3. Place a protective cover on the quartz dome on the top of the Brewer outer cover.
4. 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.
5. Locate the zenith prism assembly, which is mounted in the area of the instrument under the quartz window when the outer case is on. Refer to Figure 1 below (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)

6. Locate the HG lamp base, inside which the Hg bulb is mounted, directly under the zenith prism, referring to Figure 1. The HG lamp lies in the horizontal plane and is hidden from view inside the zenith prism assembly. Only the base that the bulb is screwed into is visible.
7. Locate the two thumb screws that secure the Hg lamp base to the zenith prism assembly. Loosen the thumbscrews. You do not have to completely remove the screws.
8. The lamp base can now be backed out of the zenith prism assembly. There is not much maneuvering room, but the lamp will come out with a little finesse. Use only a clean Kim-Wipe or other similar textile to touch the bulb. DO NOT TOUCH THE BULB WITH BARE FINGERS. If the bulb is touched by accident with skin, use some alcohol to clean it as quickly as possible.
9. At the Brewer Home screen command line give the command "B1" to turn on the HG lamp (B0 turns the lamp off). If the lamp is firing the filament will turn red, and a blue tint within the bulb's envelope can be observed if the ambient atmosphere is not too bright. Note any build up of mercury (silvery layer) on the envelope of the bulb. Excessive build up may lead to compromised HG results.
10. If the lamp is firing and there is minimal build-up, then proceed to step 19, otherwise continue on to step 11.
11. If it is visually determined that the HG bulb is not firing and/or there is excessive mercury deposit on the envelope, then turn off the Brewer power by pressing the push button on the side of the instrument before continuing. Also unscrew the AC power cable from the tracker to avoid electrocution.
12. Unscrew the mercury bulb from the threaded socket and put a new bulb in its place. Be sure to handle the new bulb only with a tissue or Kimwipe.
13. Note the small key located on the outer shell of the base that the bulb is screwed into. In order to ensure proper mercury line calibration, the filament of the bulb should be aligned in the same plane with the key in the base, i.e., in the vertical plane. The orientation of the old HG bulb may not be correct so be careful of using that as a reference point. The base that the bulb screws into is actually made up of two parts, a threaded

socket and the outer shell containing the key. There is a set of tabs that hold the two pieces together. After screwing the bulb into the socket it may be necessary to rotate the threaded socket inside the outer shell so that the filament is properly aligned with the key. In some cases the threaded socket will not rotate within the outer shell unless the multiple tabs that secure the shell to the socket are loosened first. Be sure not to touch the bulb envelope with your skin. If you touch it be sure to clean it with alcohol. Make sure the Brewer does not have power. Currently there are two styles of lamps within the network, either of which may be found at any Brewer site. One lamp style has a spherical shaped bulb while the other has a cylindrical shaped bulb. The cylindrical bulbs are more difficult to insert into the zenith prism assembly, but it can be done with a little patience.

14. Replace the AC power cable to the tracker and turn on the Brewer power by pushing the push button on the side of the instrument.
15. Check the computer to see if communication with the instrument is being established. The message "Brewer failed to respond 5 times. Check power and cables and press Enter when ready" may appear on the screen. Press Enter and the Brewer initialization process should be enacted. Once the Brewer has reinitialized the Home screen will appear on the computer monitor.
16. Give the command "B1" at the Home screen command line.
17. Observe if the HG bulb is firing as described in step 9.
18. If the bulb appears to be operating normally, continue to step 19. If the bulb is still not firing after replacement there is likely a problem with the lamp circuitry. These problems will not be addressed in this procedure.
19. If it is visually determined that the HG lamp is firing and there is minimal mercury deposit on the envelope, then carefully place the base back into the zenith prism assembly. Note the small key in the rim of the lamp base outer shell. The key mates into the key-way on the zenith prism assembly to ensure that the Hg lamp is always positioned with the same orientation.
20. Tighten the thumbscrews which fasten the HG base to the zenith prism assembly.
21. Check the desiccant and breather tube for signs of saturation and replace if necessary. This can be determined before beginning the procedure.

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. Give the "HG" command at the Brewer Home screen command line and observe if the scan is successful. A successful scan is when the peak HG counts are found at step number 15 as appearing on the computer monitor.
24. Perform the SR/SI tests if possible before returning the Brewer to schedule.
25. Enter an electronic comment (CM or CO command) describing briefly if the bulb was replaced or and any other observations made. Also enter a brief entry in the paper station log form.
26. 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).
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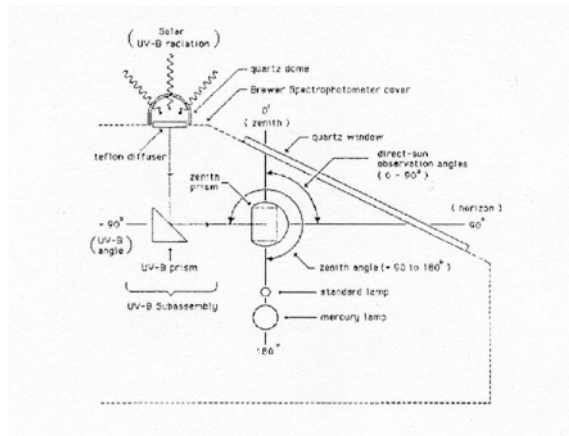


Figure 1: Spectrometer Targets for Various Zenith Angles

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