Procedure for correctly positioning the micrometer inside a Mk IV Brewer spectrophotometer

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Introduction

It is possible for the micrometer in a Mk IV Brewer spectrophotometer to be incorrectly positioned such that the diffraction grating is not moved for the first few or last few wavelength positions during a full spectrum scan. If the micrometer is set too far back (toward higher dial numbers) in the clamp the spectrometer is not able to read the first several wavelength measurements properly because the diffraction grating sine arm stays in one place. Likewise if the micrometer is positioned too far to the front (toward lower dial numbers) in the clamp the spectrometer is not able to read the last few wavelength measurements properly. Another problem occurs when the optical switch blocker ring, (the black barrel component attached to the back end of the micrometer), is set too close to the optical switch. In this case the blocker ring may cause the micrometer to become jammed and will not be able to move out of this position until someone manually adjusts the system.

Equipment

Mk IV Brewer spectrophotometer
Hex wrench set (English sizes)
Towel or cloth to cover spectrometer

Purpose

This Standard Operating Procedure (SOP) outlines the NUVMC technique for positioning a micrometer in a Mk IV Brewer spectrophotometer so that the diffraction grating will move the full operating range, thus allowing the instrument to scan its full spectral range. Also instructions are given to position the optical switch blocker ring so that it does not cause the micrometer to become jammed.

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. Give the "HG" command at the Brewer Home screen command line and observe if the scan is successful. A successful scan is one at which the peak HG counts are found at step number 15 as appearing on the computer monitor.

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. The NUVMC moves Brewers indoors for this work whenever possible.

5. Remove the black spectrometer cover by loosening the two latches and pulling the cover back. Observe and record the default position on the micrometer dial in millimeters. Never remove the cover during inclement weather and try to pick the driest, wind free day possible. DO NOT TOUCH THE MIRROR OR DIFFRACTION GRATING WITH FINGERS OR ANY OTHER OBJECT. DO NOT ATTEMPT TO CLEAN THE MIRROR OR DIFFRACTION GRATING IF ACCIDENTALLY TOUCHED AS THIS WILL CAUSE ADDITIONAL HARM TO THE OPTICAL SURFACES. Use a towel or cloth to cover the spectrometer during the procedure.

6. Observe the engineering of the micrometer system. The micrometer body is inserted into a clamp mounted to the spectrometer bulk head. The clamp is locked down via a 7/64" hex bolt. A long, brass gear is connected to a stepper motor at one end of the spectrometer bulkhead. There is a nylon gear around the micrometer body which is in contact with the brass gear. At the front end of the micrometer is the micrometer tip, which is flush against a pushrod with a ball bearing race. The other end of the pushrod is mounted against the end

of the diffraction grating sine arm. When the stepper motor is activated the brass gear rotates, in turn rotating the nylon gear and micrometer. As the micrometer rotates in the forward direction toward smaller dial numbers the micrometer tip extends, pushing against the pushrod. This causes the sine arm to move which rotates the diffraction grating, allowing the instrument to cover the spectral range 286.5 to 363 nm.

7. Give the command "W0UX" at the Brewer Home screen and move immediately to the spectrometer to watch the micrometer movement. The W0 command gives a delay of 1 minute before the UX scan begins. If the Brewer and the computer are separated by a great distance multiple W0 commands can be used or the W1 or W2 command can be inserted to give delays of 5 or 10 minutes, respectively.

8. When the UX scan begins, the micrometer will be rotated back toward larger dial numbers (16mm or so). If the micrometer is not properly positioned in the clamp the tip of the micrometer will retract inside the micrometer casing at large micrometer numbers. If the micrometer tip is observed to retract inside the casing such that the pushrod is not being moved at the first few wavelength positions of the scan then the micrometer needs to be repositioned back in the clamp slightly.

9. Continue to observe the micrometer as the UX scan reaches the middle of the spectrum (325 nm). The micrometer should read about 4 mm on the dial at this point. Then the micrometer will rotate back toward larger numbers to about 12 mm before beginning the second half of the scan (The shutter will also rotate from position 2 to position 6). When the scan reaches 363 nm, the micrometer should be near its minimum position (numbers on the dial may no longer be visible). Observe if the micrometer is still rotating and moving the pushrod for the last few wavelength positions of the scan. If the micrometer has reached its physical end point before the last wavelength position has been reached then the micrometer needs to be adjusted forward in the clamp slightly. The micrometer could become jammed at the minimum position if it is not set properly.

10. If it has been determined that the positioning of the micrometer is correct and needs no adjustment, proceed to step 20. If the micrometer needs adjustment or if it has been adjusted but is still not set correctly proceed to step 11. If the micrometer was adjusted in the clamp and is now in the proper position proceed to step 15 to check the default settings.

11. To reposition the micrometer in the clamp loosen the 7/64" hex bolt and gently slide the micrometer either forward or back slightly as determined in steps 8 and 9. Sometimes it is helpful to gently pry the clamp loose from the micrometer barrel using a small screwdriver, but take care not to apply too much torque to the clamp.

12. Once the micrometer is repositioned in the clamp replace the black spectrometer lid and give the command FR at the Home screen command line. This will reposition the micrometer to the set default position using the optical switch as a zero reference.

13. Give the command HG at the Home screen command line and observe if the scan is successful. A successful scan is one at which the peak HG counts are found at step number 15 as appearing on the computer monitor.

14. If the micrometer was repositioned repeat steps 7 through 9 to check the new position of the micrometer. If the micrometer has now been verified to be in the correct position proceed to step 15 to check the default settings.

15. Once the positioning of the micrometer has been verified using the UX scan, replace the spectrometer lid and perform an HG scan.

16. Remove the spectrometer cover and observe and record the dial position on the micrometer in millimeters.

17. Give the FR command at the Home screen command line. Observe on the computer screen or printout the measured step position of the micrometer as well as the set step position. These numbers should match within 10 steps.

18. If the measured step position is different by more than 10 steps from the set step position the micrometer zero position constant in the Instrument Constants File (ICF) should be updated (line 43) in the current file and the ICF renamed with the current Julian date. The op_st.### file should be updated to reflect the new ICF.

19. If the micrometer zero position constant is updated the wavelength calibration step number may also need updating in order to ensure the quality of the ozone scans. This number is determined via the SC scan but will not be discussed in this SOP. More information concerning the SC scan can be found in the Sci-Tec Brewer Operator's Manual.

20. *Print out a copy of the instrument constants file by typing PO.

21. Note the "WL cal step number" and the "Micrometer Zero" numbers from the printout.

22. Go to the Main Menu screen on the computer.

23. Perform an HG calibration.

24. After the HG scan is finished, remove the Brewer lid and the spectrometer cover. Note the micrometer default position.

25. Issue the teletype command on the computer by typing TT.

26. Issue the command M,10,-nnn, where nnn is the wavelength calibration number found on the printout. (Note the negative sign).

27. Issue the command M,10,-nnnn, where nnnn is the micrometer zero position found on the printout. (Note the negative sign).

28. Press home to exit teletype.

29. Check the micrometer position. There should now be ~ a 1 mm gap between the extreme right edge of the blocker and the block on which the sensor is mounted.

30. If the gap between the end of the blocker and the sensor mount appears to be less than 1mm, then loosen the set screw that holds the blocker ring to the micrometer and adjust the blocker ring to the left (it is ok to rotate the blocker ring slightly to access the set screw). Ensure that the set screw is well tightened once the adjustment has been made.

31. Reposition the micrometer to the reading noted in step 5, replace the black spectrometer cover, and do an HG calibration.

32. Test the blocker ring setting by issuing the commands W0UX. (W0 is W-ZERO)

33. (W0 will create a delay that allows you 1 minute to get to the Brewer and remove the black spectrometer cover.(use W0W0UX if you need 2 minutes, and so on)

34. Following the delay, the filters will set up, the Zenith prism will rotate to the UV port, the micrometer will move to the low wavelength end (right), and will then move in small increments toward the higher wavelength end (left).

35. Note carefully how close the blocker ring gets to the sensor mount as it moves to its rightmost position - the gap should be about 1mm. If the gap appears to be less than 1mm, then the blocker ring should be adjusted again once the UX scan has been completed.

36. Replace the spectrometer cover and secure both latches.

37. 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.

38. Perform the SR/SI tests if possible before returning the Brewer to schedule.

39. Enter an electronic comment (CM or CO command) describing briefly if the micrometer was reset or and any other observations made. Also enter a brief entry in the paper station log form.

40. 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).

* Steps 20 through 35 paraphrases a letter from Albert Maione on November 21, 1997 labeled BREWER SPECTROMETER SERVICE NOTE.

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