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but could be ordered with 1mm or 2mm compensation depending on the type of samples to be run. If there is no compensation the sample can be viewed in air, but if there is compensation, the sample will need to be viewed under a disk of the same thickness as the compensation factor (for example, sample under a 2mm BaF2 disk for an objective with a 2mm compensation factor or sample in air with an objective with no compensation). The condensers are set up the same way with the most common configuration being a compensation of 2mm. This will mean that the sample will have to be on top of a 2mm disk in order to view properly. This is why the 100 micron pinholes will come mounted to a 2mm BaF2 disk if the condenser is compensated. BE SURE OF WHAT TYPE YOU HAVE! The majority of microscopes will have an objective with no compensation and a condenser compensated for a 2mm disk. This means that for alignment purposes a 100 micron pinhole mounted on a 2mm BaF2 disk is needed to setup the microscope and test.

6. Focus the proper 100 micron pinhole and center it in the reticule using the 15X objective after it has been centered to a glass objective. Slide the 1.5mm aperture, with the beveled side down, into the upper aperture slot.If you're using a 32x, you will see the 3.2mm aperture. The aperture image should line up around the pinhole image. This proves that the upper view optics from the viewer through the aperture to the pinhole at the stage are correct. At this point the objective is focused at the proper stage height and the stage height should not be adjusted. Remove the upper aperture and move the pinhole out of field of view by moving it straight away from the front of the microscope with the Y stage adjust screw. If the system has a compensated condenser, move only the pinhole out of view so that the objective will be "looking" through the 2mm disk. This will insure that a good focal image will be seen in the next step.

7. Shift the TRANS/REFL slide to the REFL position to get the illuminator light coming up from the bottom. Install the lower 1.5mm aperture, with the beveled edge down, in the lower aperture slot.If using a 32x condensor, use the 3.2mm aperture. Using the LOWER STAGE FOCUS knob, bring the aperture image into focus. It will not be centered or even in the field of view. If it does not focus in the field of view, an easy way to find it is to lower the condenser stage (LOWER STAGE FOCUS KNOB) to a point where the spider arms or at least one arm is seen. If the center is seen, use the condenser centering screws to position the center image in the field of view. If the center is not seen, use the condenser centering screws to "follow" the arm to the center where the center and all three arms can be seen. Adjust the LOWER STAGE ADJUST KNOB until the image is in focus and then use the condenser centering screws to line the image up on the reticule. NOTE: Make sure that the image is exactly centered, as this will affect the IR throughput seen later.

NOTE: Make sure that you have a well defined image The condensor can be focused to a point that is well defined.

8. While looking at the lower aperture image, place the upper aperture with the beveled edge down, in the upper aperture slot. The image should be centered and look as if there is only the one image. Now bring the pinhole back into view. They should all be lined up and look like one round image of light. If the pinhole can not be located, remove the upper aperture, locate and center the pinhole, and then replace the upper aperture. You may need to shift the TRANS/REFL slide to get the light coming down from the top to find the pinhole. Be sure that the light is

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coming up from the bottom when viewing the complete alignment. The images will then all be centered and in focus.

NOTE: Be sure to go back and check this alignment periodically because this is the same path that the IR will follow.

9. Fill the detector with liquid nitrogen and let it cool down for 15-30 minutes. Select detector 2 in the software, MCT velocity, APT=FL, GAN=2, and initiate a data collect to get the flipper mirror and detector signal to change. Push the swing away mirror knob, that is located on the lower left hand side, all the way in. Slide both VIEW/IR slides to the IR position and the TRANS/REFL slide to the TRANS position. Use the appropriate alignment program to find an interferogram. If no signal is detected, go back and check all slides, cables, and the visual alignment. It will be helpful to increase the gain at this point to 16 or 32 to find an interferogram. Once a signal is found the only mirror that should be adjusted is the very first input mirror. This is the one on the slide. All other mirrors are fixed in place and some are 3 and 4 function mirrors. At this point there should be a signal that fills the digitizer at GAN=2 in transmittance. Run a 100% line to verify signal to noise in transmittance. See specifications section for proper data collect parameters.

10. Switch over to reflectance mode by first switching both VIEW/IR sides to the VIEW position and the TRANS/REFL slide to the REFL position. Focus with the 15X objective on the gold mirror surface with the upper aperture in place. Set GAN=4 for reflectance. Slide both the VIEW/IR slides to the IR position and get into the proper alignment program. The interferogram should be at a full digitizer size. If it is not, go back and check all slide positions etc. If this does not help, adjust R1 the reflectance 45° mirror to maximize the reflectance mode. A .035 allen wrench is needed to make this adjustment. This is the only mirror that can be adjusted for the reflectance path without affecting the transmittance path.

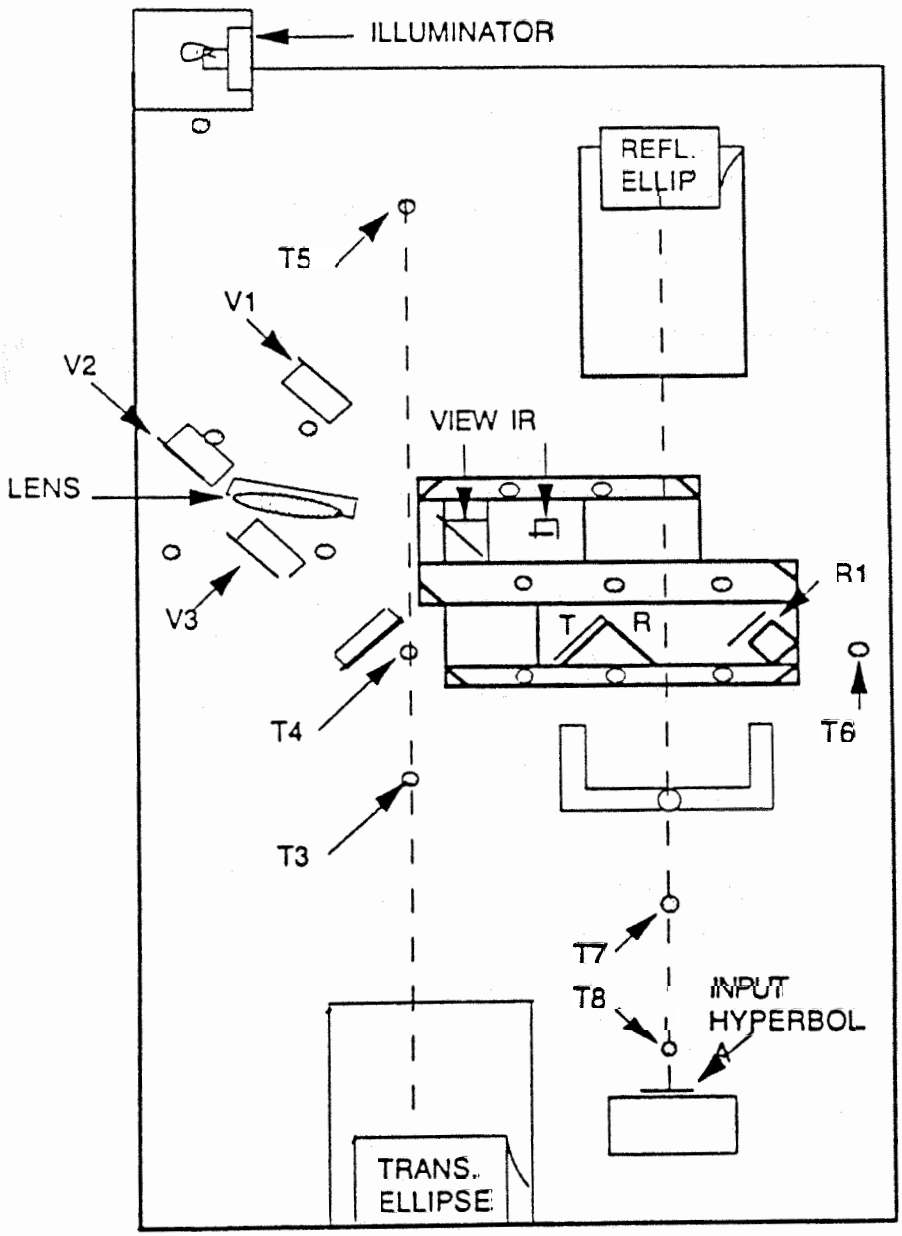
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Beampath Layout (Back View)

V= visible beampath
T= transmittance beampath
R= reflectance beampath

Use 060-707400 alignment post for T3-T8.

USE 060-707500 alignment post for side wall alignment holes



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Alignment in Brief

The alignment of this microscope differs from the procedure for the IR PLANbecause the illuminator on the microscope does not illuminate the detector beam path. An external illuminator was designed to be placed on the sample stage and be powered by the microscope (395-701700).

This illuminator can also be used to track several of the beam paths as well as setup of the detector optics. To power the external illuminator remove the bulb from the internal illuminator and plug the two pin connector into the socket.

DO NOT TOUCH THE BULB, AS FINGER OILS WILL DAMAGE THE BULB ONCE HEATED.

Setup the detector optics

After having installed the front end optics, place the external illuminator on the sample stage, move the upper IR/VIEW slide to VIEW and adjust the X,Y sample stage controls to view the bulb filament. Use the main stage focus adjustment to focus on the filament coils (it is not critical which surface of the filament is in focus). Next move the upper IR/VIEW slide back to the IR position, and install both upper and lower apertures, beveled edge down.(15x objective uses 1.5mm, 32x objective uses 3.2mm, etc.

Focus the filament coils on to the lower aperture, using the lower stage focus adjustment. (It is not critical which surface of the filament are in focus.) The coils should be seen illuminating onto the countersunk area of the lower aperture.

Move the lower IR/VIEW slide to IR, and the slide below that to TRANS MODE. The lower image is sent on to "trans ellipse" and can be checked at "T3" (Image centered). The upper image is sent on to "refl ellipse " and can be checked at "T7 and T8". (Use alignment post 060-707400) **Need illustration** ?

1. The image should hit the center of the IR hyperbola on the VIEW/IR slide. The image then hits the center of the lower flat mirror below the two slides. Then the image should hit the detector ellipse in the center of the mirror . At this point focus the ellipse by viewing the visible spot on a business card where the detector will eventually be placed. It should be round and have well defined edges. It should also look circular both before and after focus. (See figure 1)

2. Leave the business card in place at the detector (transmittance) focus and make a mark on the card where it focuses. Check that the transmittance and reflectance detector beam paths are coaxial. To do this, move the TRANS/REFL slide to REFL. Check to see that the image is cut in half by R1, its "stop" (on lower slide near T4) should already be set to do this.

3. Check to see that the "half image" hits the IR hyperbola on the lower VIEW/IR slide in about the center, and that the image on the lower flat (below both slides) is centered. Look at the business card, the spot (focus) should be in the same place when switching between transmittance and reflectance modes. If not, slight adjustments can be made to R1 to make the two beams coaxial. You may need to go back and forth a few times between the different modes to be sure.

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IT SHOULD BE NOTED THAT THE IMAGE (FOCUS) AT THE BUSINESS CARD WILL BE IMPROVED IF THE TRANS/REFL SLIDE IS NOT FULLY ENGAGED. THIS EFFECT IS DUE TO OBSCURATION OF THE ILLUMINATION WHEN THE SECONDARY MIRRORS OF THE OBJECTIVE AND CONDENSER ARE CENTERED. THEREFORE BY MOVING THE SLIDE A LITTLE OFF FROM ITS STOP MORE LIGHT IS ALLOWED TO PASS AND A CLEANER FOCUS IS SEEN.

BEFORE ADJUSTING R1,

a Is the beam path T7 and T8 correct?
b Is the stop for the TRANS/REFL slide set to "half " the image from refl ellipse to R1? If these two steps are found to be true, continue and adjust R1. (.035 allen wrench is required)

At this point the detector ellipse and transmittance-reflectance path are functional. With both IR/VIEW slides in IR mode and the TRANS/REFL slide in the TRANS mode the stage illuminator can be tracked back to the modulator the IR input mirror of the microscope can be adjusted to center the image to the laser.

Remove the stage illuminator and plug the internal illuminator bulb back into its holder. (DO NOT TOUCH THE BULB, AS FINGER OILS MAY DAMAGE THE BULB WHEN HEATED) Align the front end optics, Objective, Condenser, pinhole (window is required to match condenser if 2mm compensated) and both apertures, then mount the detector and verify performance.

TEST SPECIFICATIONS (167-004700)

It is necessary to place a window of the appropriate thickness below the sample if the Condenser is compensated. (Currently 2mm compensation). If you do not, you will see a halo about the pinhole, and reduced throughput will result.

Alignment in Detail

1. Install the bi/trinocular, IR Objective, Condenser. When installing the Reflachromat Condenser be sure to rotate the two secondary mirror adjustment screws to the rear of the unit so they can be adjusted later if necessary.

2. Place the 100 micron pinhole in its sample holder with the window side down, and mount both on the sample stage.

3. Move both the upper and lower IR/VIEW slides to the VIEW position, and move the TRAN/REFL slide to REFL. This should bring light to the sample from the top. (Reflectance mode)

4. Turn the illuminator on and adjust the intensity and iris to illuminate the full field of view, while viewing the pinhole sample with the objective.

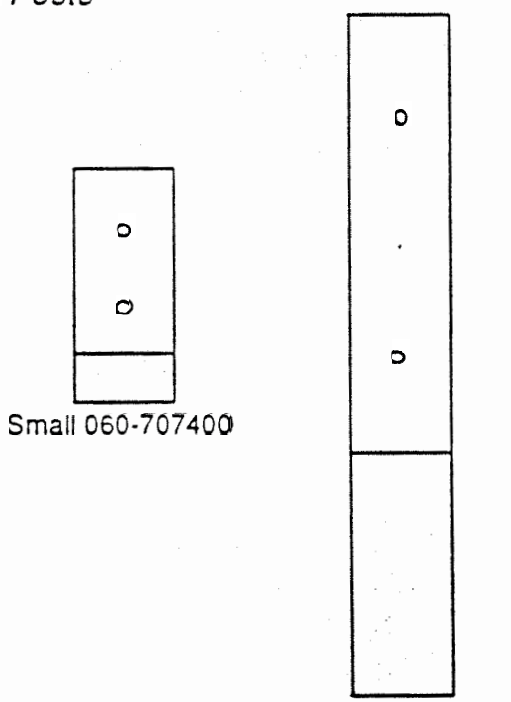
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5. Center the pinhole on the reticule (crosshair) using the X, Y sample stage adjust. Adjust the eyepieces for sharpest line and numeral contrast. Focus on the pinhole image.

6. If the Objective is the "fixed" type, check to see that the image is centered and focus is acceptable.
If the Objective is the "adjustable" type, check to see that the image is centered and focus is acceptable, if it is continue to 8, if not see"OBJECTIVE ADJUSTMENTS".

7. Install the lower aperture with the bevel side down. Using the X, Y stage adjustments, CAREFULLY move the pinhole sample out of the way, being sure not to change the sample stage height. (If the pinhole were still there the upper Objective would be focused on it.). With the 2mm window in the beampath adjust the lower half of the stage to bring the "glow" to a focus. Omit this window if a Reflachromat Condenser is used. It may be necessary to center the lower Objective (Condenser) using the Condenser centering adjustments and then focus. A halo will be seen if the Condenser is compensated and the appropriate thickness window is not used.

Microscope Alinment Posts



Small 060-707400

Large 060-707500

It should be noted here, that one Condensor is sample compensated for a 2mm window. 160/10 15X Objective (not compensated) 869-0047-410
160/2 15X Condenser (2mm compensated) 869-0047-417

8. At this point both the infrared Objective and Condenser should be centered and able to achieve a good focus. Even though the next step may seem to digress, steps 1-8 are necessary to insure all the front end optics are coaxial before the rest of the optics can be checked.

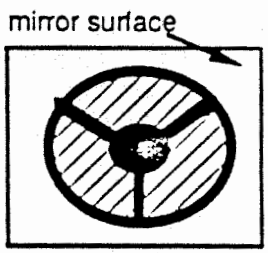
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9. Place the external illuminator fixture on the sample stage (395-701700). Unplug the internal illuminator bulb and plug the external illuminator into the bulb socket. DO NOT TOUCH THE BULB WITH YOUR FINGERS, IF THIS SHOULD HAPPEN REMOVE ANY OIL ON THE BULB WITH ALCOHOL. Adjust the lower stage focus until the coils can be seen clearly illuminating onto the countersunk area of the lower aperture. Then with the upper aperture temporarily removed and the upper IR/VIEW control selecting VIEW, adjust the main stage control until the fixtures coils come to focus, as seen through the eyepieces. Replace the upper aperture when these steps are completed.

10. With both the upper and lower IR/VIEW slide controls selected to IR, and the TRAN/REFL slide control selecting TRAN mode, place a business card over the detector flat mirror. There should be a full image in the center of the flat mirror. (See figure below) Remove the card.

This is the obscuration of the secondary mirror and the spider arms of the Objective or Condenser





11. Check to see this image centered onto the detector ellipse. If it is not centered, adjust the detector flat mirror until it is.

12. Adjust the three height adjustments on the detector stage out approximately one tenth of an inch. This should place the detector close to its final height.

13. Place a business card test fixture onto the detector stage and move it to get the tightest focus possible. Then adjust the detector ellipse for the best circular focus.

14. Place the business card back on the detector flat mirror and trace around the full image. Move the TRAN/REFL slide over to REFL mode. Is the reflectance image cut in equal halves by R1? If not, is the beam coming down from the reflectance ellipse traveling down the T7 and T8 line? (Alignment post 060-707400). If it is down T7 and T8 line then adjust the stop closest to T4 on the TRAN/REFL slide to cut the beam into equal halves.

15. The half image should hit the detector flat mirror in the same place as the full image. That is, the half image should overlap one half of the full image. If steps 15 and 16 are correct then after removing the business card, the reflectance image should be focused at the same spot on the business card as the transmittance image. Slight adjustment to R1 reflectance mirror can be made to insure that the two beampaths focus at the same spot. (.035 allen wrench is required)

~~Insert note about the slide What note?~~ NEVERMIND

16. At this point the IR input mirror of the microscope can be adjusted. This is done in the transmittance mode so that the full image can be aligned down the laser alignment holes on the main bench. This beam can be tracked back to the beamsplitter and even to the iris if one is installed on the spectrometer. The external stage illuminator can now be removed. Reinstall the internal illuminator

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bulb. AGAIN, DO NOT TOUCH THE BULB WITH YOUR FINGERS. Check to see the internal bulb shines onto the center of the scope iris.

17. The detector can be placed onto its stage. Realign the front end optics as before. (Steps 2, 3, 5, 7 and 8)

18. With the front end optics aligned and the 100 micron pinhole and redundant apertures in place, select both IR/VIEW slide controls to IR, and select TRAN mode operation. Set the computer gain to 2, and enter the alignment mode of the operating system.

19. Adjust the detector to get maximum throughput. This is the critical step of this alignment guide, therefore some additional text on detector alignment is supplied. (See "Detector Alignment")

20. Once the detector is set up (transmittance mode), move the TRANS/REFL slide to REFL. Check to see that the stop for the slide is correct, that is that the energy is at lease one half of that of the transmittance setting. (The gold mirror is required at the sample position.) If it is not slight adjustments can be made to the R1 mirror x, y screws.

21. At this point the front end optics can be setup and aligned to perform final tests. To do this verify steps 2, 3, 5, 7 and 8 of this alignment guide.

22. Select the collection parameters as specified in 167-004700 Test Specification. Run the signal to noise tests for transmittance and reflectance and provide plots of each from 4800 cm-1 to the low end cutoff for that detector type (650 cm-1 for MCTA, 500 cm-1 for MCTB). Also provide a single beam of both modes.

Detector Alignment

The detector alignment is critical to performance. The focus image and position must be known before a detector can be mounted with any success. The visible illumination can be used to determine if the detector mirror is focused to a usable spot. Use a business card taped to a metal block to look at the image. The fixture required to illuminate the detector optics is called the Scope Stage Illuminator (395-701700). This fixture is used to setup the focus of the detector optics. Patience is required as the element of the detector is only .25mm square (.010 inch square). Some general observations should be noted.

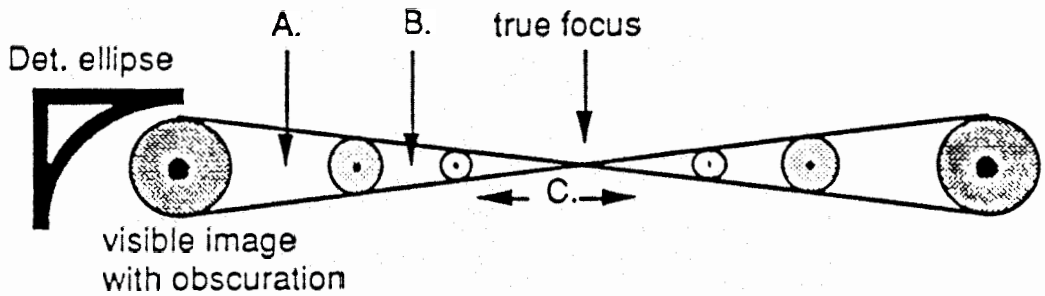
1. The detector mirror is very fast; it comes to a focus very quickly (converges) and then it diverges quickly. If the detector ellipse is focused correctly its image should come to focus as a circle constricting, then diverge to a "mirror image circle." At no time should the image appear to fold or give a comet tail effect.

2. The closer one gets to the true focus the quicker large throughput numbers will come and go. If you are close to the focus, any movement should dramatically effect throughput. For example, if the detector is sitting at point A the throughput will not vary much with movement, at point B the throughput will be higher due to a larger flux density of IR but small movements other than out of the cone will not vary the throughput much. At true focus the throughput will jump and will be hard to maintain in the tighten down process. At point C height adjustments will cause

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the throughput to jump, but a little movement may maintain the same throughput count. (See the illustration below)

When you feel you are getting close to focus move the detector back and forth along the beam path and find the midpoint. Now adjust the height up by .01 inch and see if the distance between throughput / no throughput is shorter or longer. If it is shorter you should be below focus, and you should also see more throughput. Continue these steps until focus is found.



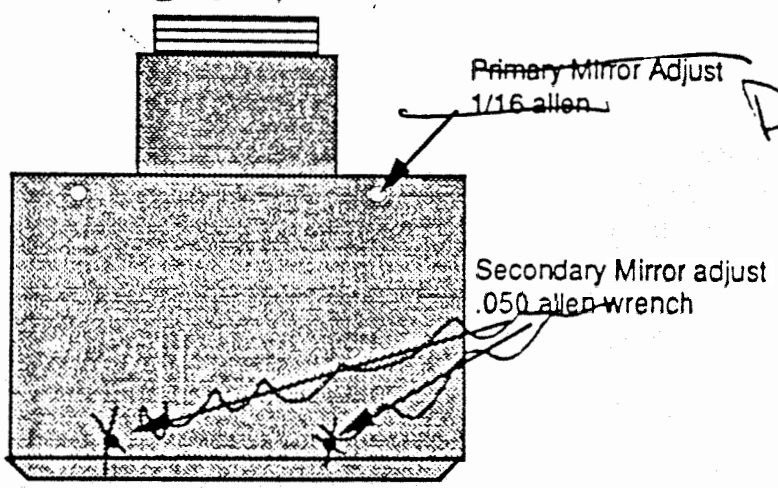
Once the detector is tightened down, the detector ellipse can be tweaked to verify maximum throughput is achieved. KEEP IN MIND THAT IF THE THROUGHPUT COUNTS GO DOWN, THE DETECTOR HEIGHT IS CORRECT. IF THEY GO UP, THE HEIGHT WAS NOT CORRECT. GO BACK TO STEP 1 AND TRY AGAIN.

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Objective Controls and Alignment

Reflachromat Controls

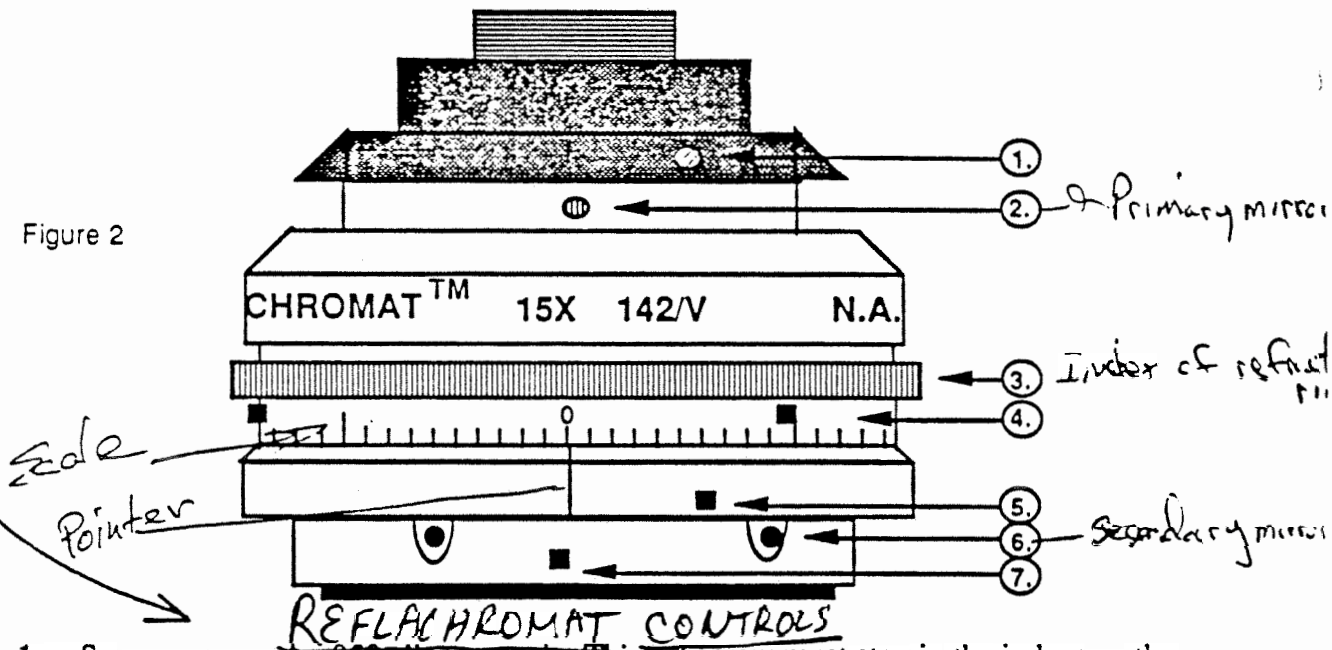
" Fixed Objective "



DO NOT TOUCH

FIGURE 3

Figure 2



REFLACHROMAT CONTROLS

1. Set screw accepts .050 allen wrench. This set screw must stay in the indent on the brass tube. The indent can be seen by looking into the top as shown.

2. These screws (3) accept 1/16 allen wrench. They are the primary mirror adjustments. They are not spring tensioned and should not be loosened unless critical adjustment is necessary. After course adjustment is made, fine adjustment can be done by over tightening, but caution should be exercised due to the small screw size.

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3. This is the index of refraction ring. Specific calibration for different sample indices can be found in the applications manuals. This text will explain general setup and zeroing only.

4. These screws (3) accept .028 allen wrench. They allow the scale to rotate. It is not intended to be moved to correct other possible problems. Caution is advised.

5. These screws (3) accept .028 allen wrench. They allow the scale pointer to rotate. It is not intended to be moved to correct other possible problems. Caution is advised.

6. These screws (3) accept .050 allen wrench. They adjust the secondary mirror. There is a tension spring inside assembly.

7. These screws hold the critical assembly together. DO NOT TOUCH!

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Index of Refraction, Zeroing and Centering of the Adjustable Objective (Reflachromat)

This text does not apply to the fixed objective as it is compensated for 2 mm sample windows.

1. Determine what the true zero point of the index of refraction (in air) optically. To do this a 100 micron pinhole should be setup on the sample stage. Focus on it with the upper illuminator on medium intensity, and center the image onto the reticule.

Is there a ghost or aura around the image, even though the focus is as good as it can be? Then your index of refraction may need adjusting. (See figure 8 and 9)

2. Simply adjust the index ring a few tick marks left or right, then try to refocus using the main stage focus. If its ghost or aura is reduced, continue doing this in the same direction until the best focus (minimum ghost) is obtained. If the ghost or aura became worse, go the other direction and continue adjusting the index ring and refocusing, until the best focus is obtained.

3. Next the two secondary mirror adjustment screws (#6 above) should be checked to see that they are accessible (toward the rear) with the Objective mounted into the turret position intended for its use. If they are continue on to the next step.

4. If when installed, the adjustments are not toward the rear, loosen #1 but be sure it is still in the indent. The next step will be easier to realign if you count the turns and do this uniformly to all three screws (# 2). Next loosen #2 (three places) and turn the whole assemble slightly counterclockwise to unbind the threads and finger grip. Then while holding the finger grip with one hand, rotate the whole assemble until the secondary adjustment screws are facing to the rear. (Don't worry about the zero not being in the rear, that's next). When this is complete, retighten the #2 screws each as before.

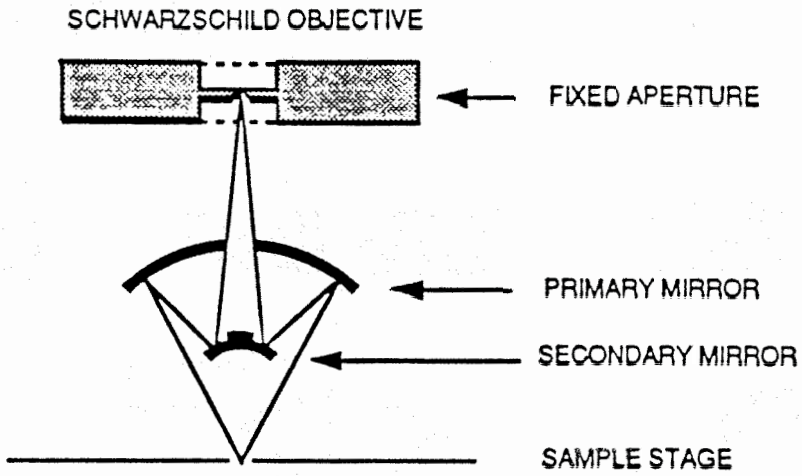
This is only course alignment, fine alignment well follow later in this text.
Next tighten down the finger grip screw. (#1)

5. Now with the assembly back together and all screws tightened down, loosen up #5 screws and place the scale pointer in between the two secondary mirror adjustment screws (#2). Next loosen up #4 screws and rotate the scale ring to place zero on the tick mark of the scale pointer.

Practical Objective Alignment

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The type of objectives used on all of the microscope products is a Schwarzschild, which has the property of focusing point to point.



This practical alignment technique is one that can be performed by the user without special jigs and without optical expertise. The technique that follows is practical, with illustrations of the result or image that should be obtained. The adjustable objective is the subject of this text, however the information applies to any Schwarzschild design. (Despite any lack of adjustments, the images do apply.)

1. Install the bi/trinocular, eyepieces, IR Objective (with the secondary mirror adjustments facing to the rear) and the 100 micron pinhole.

2. Focus (as best as can be achieved) on the pinhole image, center this image onto the reticule of the eyepiece using the x, y stage adjust. If things are close to correct the image should look like the figure below.

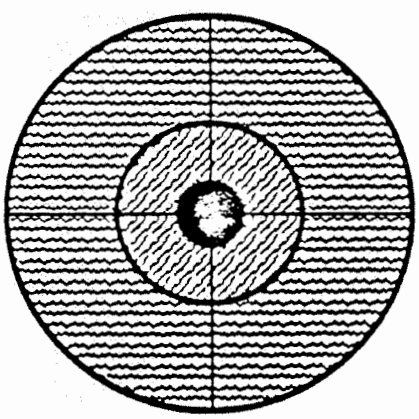


FIGURE 4

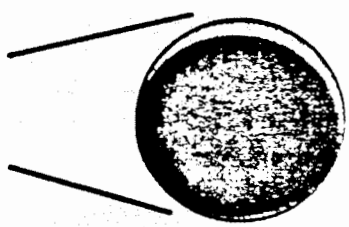


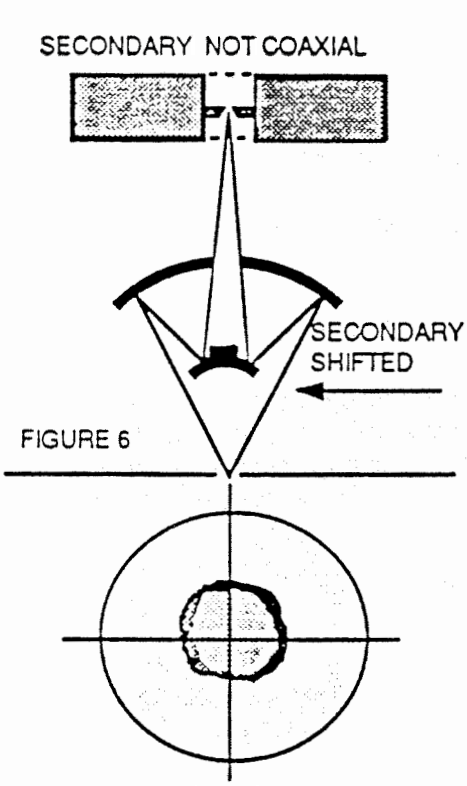
FIGURE 5

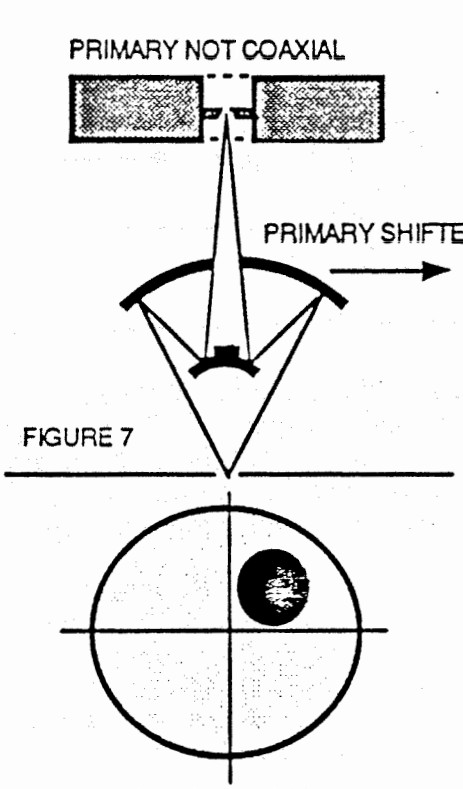
3. If the dark image (the hole) is centered on the reticule and the edge definition is blurred (as in figure 5 and 6) then the secondary mirror adjustments must be tweaked to get the best edge definition. When adjusting, it should be noted that the image will not be centered on the reticule; this is normal and well be corrected be the primary mirror adjustment that follows.

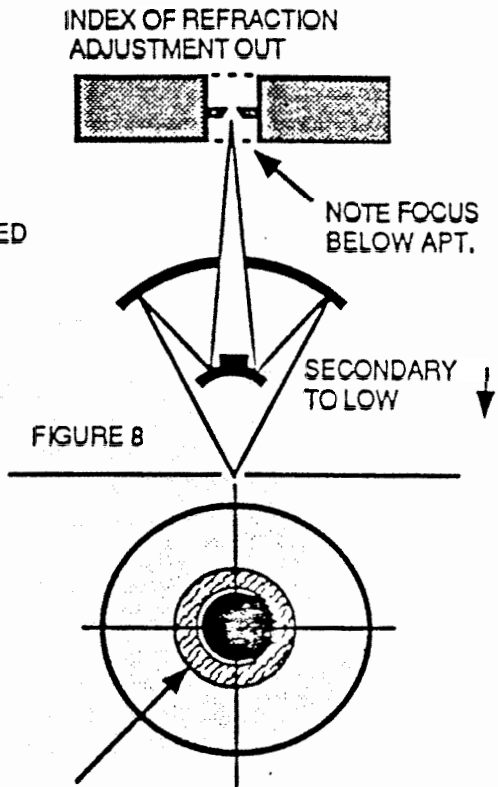
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4. When the dark image has well defined edges but the image is not centered then the primary mirror adjustments need to be tweaked (see figure 7). See #2 of "Objective Controls and Adjustments" above. Several things need to be mentioned here. The first is that step 3 and step 4 should be reiterated to fine align, and a good second test is to slowly defocus and observe that the edges collapse uniformly.







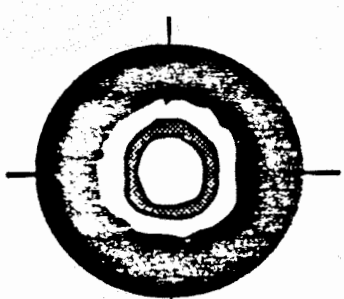


Fig 9

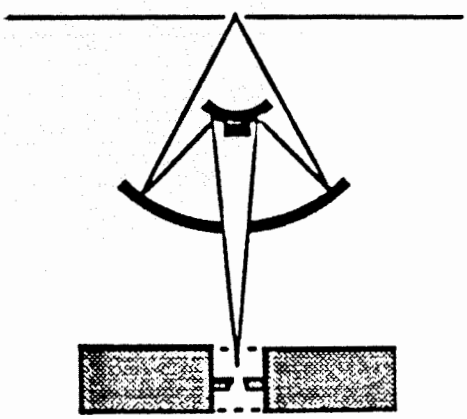


FIGURE 10

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