

A woman with dark hair pulled back, wearing a white lab coat, is looking through a white and black compound microscope. The background is a soft, out-of-focus light color.

Troubleshooting Clinical Microscopes

**A Comprehensive Guide to the Proper Use,
Daily Care, Troubleshooting, and Repair
of Clinical Microscopes**

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A note from the author ...

This troubleshooting guide is quite unique!

For me personally, it represents the marrying of two passions, the world of the clinical laboratory and that of professional microscope servicing.

The guide is not overly technical and seeks to bridge the gap between technical detail and functional understanding. The subject areas are topical and based upon commonly occurring microscopy problems experienced by Medical Technologists and Biomedical Engineers.

Clinical laboratory microscopes have not really changed very much over the last century. Because of this, the information in this guide is designed to be somewhat timeless, and therefore not specific to any particular manufacturer or model of microscope. Always timeless is our need to enjoy life, so there has been an attempt to interject some light-hearted humor as it relates to microscope use in clinical laboratories.

This guide is the product of 10 years experience as a Medical Technologist and 20 years as the owner of a successful microscope servicing company. After performing over 50,000 microscope preventative maintenance servicings, I have a pretty good handle on what your real world needs are.

My hope is that this guide will serve your needs well.

A handwritten signature in black ink, which appears to read "Mark Moore". The signature is written in a cursive, flowing style.

Mark Moore, MT(ASCP)
Owner – Microscopy USA

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Thank You!

Mark Moore - Owner

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Problem Solving Guide – Most Common Complaints

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Oil Immersion Objective Troubleshooting

How they work ...

Oil immersion objectives require that a drop of immersion oil be placed on the slide, and then this objective is rotated into position with its tip immersed in the oil. The oil is specifically designed to have similar optical properties as glass, and therefore reduces the bending (refraction) of light. This then allows for higher magnifications, up to 1000X (Ocular 10X times a 100X Objective).

What can go wrong ...

1. Most manufacturers' suggest a 50/50 mixture of high and low viscosity oil to allow for movement of the slide without breaking the oil's contact with the objective. If you use straight low viscosity oil, it will spread out quickly on the slide and lose contact with the oil immersion objective. If you use straight high viscosity oil, it will maintain good contact with the objective, but will be too thick to move with the slide. (You might wonder why companies don't make a medium-viscosity immersion oil. For the answer go to page 13.)
2. There may be a small bubble lodged at the tip of the objective producing a blurry image. Simply move the slide rapidly left and right a few times to dislodge the bubble. The image clarity should return.
3. The tip of the objective may be dirty or covered with debris. (See page 16)
4. If the immersion oil in the dispenser container next to the microscope is hazy (turbid), then you have yeast growing in your oil which can affect image quality. Throw out this oil, sterilize the containers and refill with a 50/50 mixture of high and low viscosity immersion oil. (See page 16 for more information.)
5. The tip of the objective may be scratched or pitted. (See page 16.)
6. The seals on the tip of the objective may be damaged allowing immersion oil to leak inside and damage the internal optics. This will cause the image to lose resolution. This leakage can occur in minutes, or slowly over a month's time. Repairing oil-damaged objectives is not practical since the internally leaked oil damages the optical coatings on the many internal lenses within the objective. If this leakage has occurred, you now own an expensive paper weight. Check to see if it's still under warranty! Remember that microscopes are often sold with extended 3 and 5-year warranties!
7. If the center of the image field is in focus, and the edges are blurry, the causes can be a dirty tip on the objective, immersion oil has begun to leak inside, or you purchased a cheap "Achromat" quality objective. (See page 14.)
8. No other type of oil can be substituted for immersion oil, not motor oil, sewing machine oil, or any other kind. (Yes, some folks try this.)
9. Some misguided person told you to "soak" the tip of your oil immersion objective in immersion oil or Xylene and now the resin seals have broken. See step #6 on this page.



Condenser (Köhler)* Alignment

1. Focus a slide under the 10X objective, with the sub-stage condenser in positioned as close to the slide as possible. Also, swing out of position any accessory lenses mounted on the condenser.
2. Close the sub-stage condenser iris to approximately the 90% closed position.
3. Close the field iris-diaphragm on the microscope to the 90% closed position.
4. Now, when viewing through the oculars, the image field should still be visible – but significantly darkened. In addition, there should be a small bright circular spot, which represents the light coming through the small opening in the field iris-diaphragm.
5. On the bracket that holds the sub-stage condenser, you should find two alignment screws (knobs). These knobs will be offset 45° to the left and right. Look through the oculars and adjust these knobs to center the bright circular spot within the image field. This centers the condenser directly under the objective. (Some microscopes have no centering screws to adjust; the manufacturer has removed this option to make the condenser alignment “idiot proof”. Please don’t take this insult personally – see page 47.)
6. The next step is to slightly raise and lower the condenser height, and while viewing through the oculars, make the edges of this bright spot as crisply focused as possible. On most microscopes, the condenser will now be near its upper range of motion, and within ¼ inch of the slide. (On some microscopes it is not possible to bring these edges into focus. If so, ignore this step)
7. You are almost done, return the microscope to its normal usage settings by opening the field iris 100%*, and opening the condenser iris to about the 30% open / 70% closed position. This position of the condenser iris is somewhat arbitrary; you are looking for a position where there is superior image resolution (sharpness), but not so far closed that artifacts and shadows begin appearing in the image field.

Danger to the patient ...

This final (~70% closed / 30% open) positioning of the sub-stage condenser iris is generally recommended for all clinical microscopes. It is especially important in Urinalysis, where leaving the sub-stage condenser iris too far open will cause excessive light to be reflected and refracted within the condenser on non-phase contrast microscopes. **This in turn causes the image to have a glare-like haziness and eliminates any possibility of seeing a Hyaline cast.** Hyaline casts are caused by patients having low urine flow, or concentrated urine caused by dehydration, vigorous exercise, or serious renal disease. In this instance, not adjusting your microscope properly can affect patient safety.



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*Köhler (August) was a famous microscopist who discovered in the late 1800's that if a collecting lens was positioned close to the bulb of a microscope, that the image of the bulb could be focused within the condenser located just under the stage. This reduced the possibility of the image of the bulb itself becoming visible through the microscope. *What a great idea ... Köhler attended one of our first training classes** in 1843!* This great design idea requires that the sub-stage condenser be properly positioned.

***Just kidding ... the class was really held in 1844! (August made most of his discoveries working the night shift – see page 47.)*

Parfocality ... what is it?

Parfocality relates to the ability to move from objective to objective with minimal refocusing. Think of “par” in terms of hitting par on a golf course. Par is the expected comparative score for that golf course; in the case of microscopes it is the expected focusing point between objectives. Specifically, if you focus an image under the 10X objective and move to any higher magnification objective, you should not have to rotate the fine adjustment mechanism more than $\frac{1}{2}$ of 1 revolution. (Remember that any oil immersion objective will need immersion oil on the slide to bring the image into focus.) Microscopes are manufactured to be parfocal in all magnifications 10X and higher. Objectives with a magnification below 10X are often manufactured to NOT be parfocal with the higher magnification objectives.*



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There are only a few common reasons why a particular objective would not be parfocal ...

- 1. The objective has come unscrewed somewhat from the nosepiece of the microscope.** This would alter the relative height of the optics in that objective and require additional focus mechanism adjustment.
- 2. The objective is actually from a different microscope or manufacturer.** Many, but not all, objectives are compatible on other manufacturers’ microscopes. If they are compatible, they will produce an image within about 6 full revolutions of the fine focus mechanism. (The fine focus knob can be rotated either clockwise or counterclockwise to bring the image into focus.) Remember, objectives should never strike the slide; always go slow if you attempt to swap objectives between microscopes. If you switch objectives and the image is not in focus within the 6 full revolutions of the fine focus mechanism, the objective is not likely compatible on that microscope. (Go to page 24 to discover how to reduce the amount of rotations of the fine focus mechanism and re-parfocal an objective.)
- 3. Immersion oil has begun to leak internally into the objective.** If immersion oil leaks inside any objective, it will alter the focusing point of that objective as well as the resolution (sharpness) of the image.

***“You may not want to do that!”**

Parfocality vs. Parcentration

A rather obstinate pathologist once asked me to correct a parfocality problem on his new microscope; the 2X objective had been made by the manufacturer not to be parfocal, and he wanted it corrected. I explained that the objective was not parfocal to prevent the higher magnification objectives from hitting the slide. I explained the optical design reasoning for such a situation, and that if I corrected his parfocality problem by adding an excessive number of parfocality shims to the objectives, that in turn might create a parcentration problem! He quickly changed his mind. Bottom line ... don’t try to make low magnification objectives (less than 10X) parfocal with higher magnification objectives; they were made that way for a worthy purpose.



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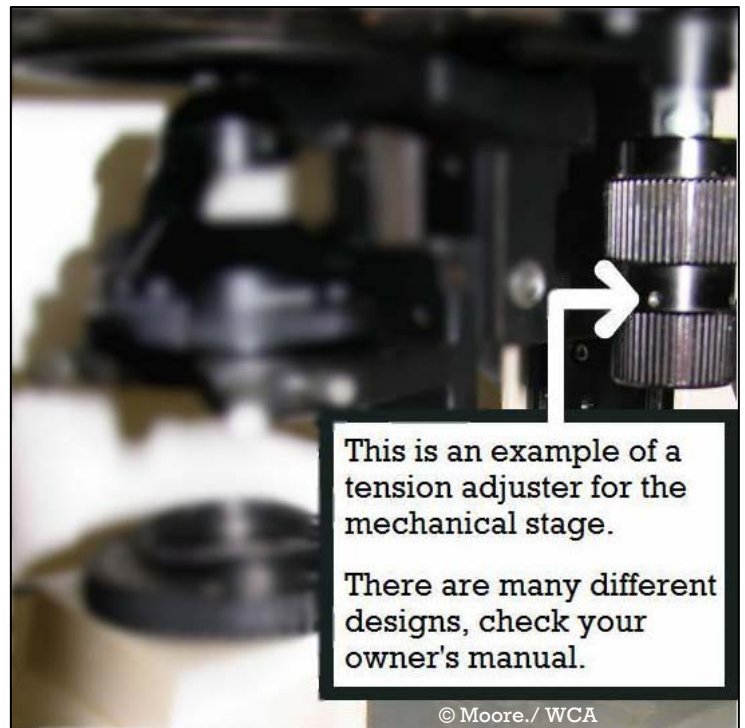
Avoiding Carpel Tunnel Syndrome & Lawsuits

Problem: cytologists and pathologists spend most of their day using a microscope that, if not properly adjusted, can lead to Carpel Tunnel Syndrome, surgery, long-term disability claims, and lawsuits.

Repetitive wrist motion, exactly like those required for microscope usage, can lead to Carpel Tunnel Syndrome. Nerves become swollen and constricted within the narrow passageways through wrist bones and can produce debilitating results. Every microscope has a way to adjust the tension on the mechanical stage controls that affect both the X and Y direction of travel. These tensions need to be set so that the stage moves freely - with a minimum of resistance.

Adjusting the tensions on newer model microscopes is quite easy, as they have a tension adjusting wheel built right into the mechanical stage control knobs. They can be adjusted so that stage moves freely, but does not drift.

Older model microscopes present more of a challenge when adjusting the mechanical stage tensions. There are all types of designs that include hidden pressure plates and friction pins. If you have the manual for these microscopes it will identify these adjusters. If your manual does not show any such adjustments, then the microscope has been designed so that only trained service personnel can disassemble and adjust these tensions. Speaking on behalf of microscope servicing folks, let me say that some models of microscopes are a pain in the posterior to adjust. It can take over an hour of careful work to make what appears as a simple adjustment. Lab managers don't like getting bills for such extended labor costs, however they need to weigh that cost against the expense of losing a valuable employee for months at a time, or having the hospital pay 20 years of disability payments.



Note of concern ... most service personnel are male, who tend to adjust the stage tension so that it feels "free-moving" to their own hand strength. Most cytotechnologists are female, with slightly less hand-strength than men. If the stage still feels too tight after the service person adjusts the scope, then it needs to be readjusted to suit the needs of the cytotechnologist.

Why you should try to blame the Night Shift!



How the Day Shift views the Night Shift in a Clinical Lab ...

Those guys just kind'a hang'n out, processing a few specimens, do'in some quality control, a little chit-chat with the 3rd floor nurses, and sometimes catch'n up on a few zzz's.

How the Night Shift views the Night Shift in a Clinical Lab ...

Two crossmatches cooking, someone's coding in ICU, the ER doc wants those blood gases NOW, and some nursing supervisor is on the phone wondering why you are late for morning pick-ups.

Problem: you come in some morning and find out that you get tremendous eyestrain when looking through the primary scope in the hematology lab. The night shift said they also had problems with it all night, but you are suspicious ... the scope was just fine yesterday afternoon.

Upon close examination you find that the top lens of one of the oculars has been turned upside down by someone trying to figure out how to get that speck of dirt out of the image field. "The night shift must have done it", you exclaim. The fact is that you are correct. In a rare moment of mental recuperation, a night shift hero has demonstrated their ability to tackle any problem and overcome any obstacle. This is what makes night shift folks soooo wonderful! You can blame them; they really don't mind, it kind'a comes with the territory.

How the Night Shift views the Day Shift in a Clinical Lab ...

Just back off; you have no clue!

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