Leitz Dialux and Laborlux (160 mm t.l.) Condenser Holder and Condenser Focus Block

The condenser assemblies of Leitz Dialux and Laborlux microscopes with 160 mm mechanical tube length have two serviceable parts; the condenser holder and the condenser focus block. Both parts are described here.

Scope & Introduction

These maintenance notes describe the disassembly, cleaning, greasing and reassembly of Dialux/ Laborlux condenser holder assemblies (not including the condensers, however.) The notes apply to Leitz Dialux and Laborlux microscope models from the 160 mm mechanical tube length period. There are only some minor design differences (Figure 1 and Figure 2) between the condenser holders for the Dialux family (Dialux 20, 20EB, 22 and 22EB) and for the later Laborlux family (for example, Laborlux D, K, 12 and S.) The holders have the same dovetail mount for the condensers, so both holders fit Dialux as well as Laborlux condensers from the 160 mm tube length era.

Figure 1: The Dialux 20/22 family condenser holder viewed from the underside.

Figure 2: The Laborlux family condenser holder viewed from the underside.

The later Diaplan and Aristoplan microscopes have different and somewhat more elaborate condenser holder designs. This can be confusing because the dovetail mounts are also identical, but optically the Diaplan and Aristoplan condensers are not compatible with the Dialux and Laborlux microscopes. This is because the Diaplan and Aristoplan microscope condensers lack an aperture diaphragm - the aperture diaphragm is instead integrated into the microscope foot.

Grease

The condenser holder and focus block functions are non-critical and forgiving regarding the choice of grease. I have used Super Lube Multi-Purpose Synthetic Grease with Syncolon (NLGI grade 2). It is an inexpensive and ubiquitous grease.

Maintenance Notes

1. Remove the objectives, condenser, and head from the microscope.

To facilitate the work and to avoid contamination of the sensitive optical components, the objectives, the head with the eyepieces, and the condenser should be removed from the microscope and stored protected from dust.

2. Remove the condenser holder and the condenser focus block from the microscope.

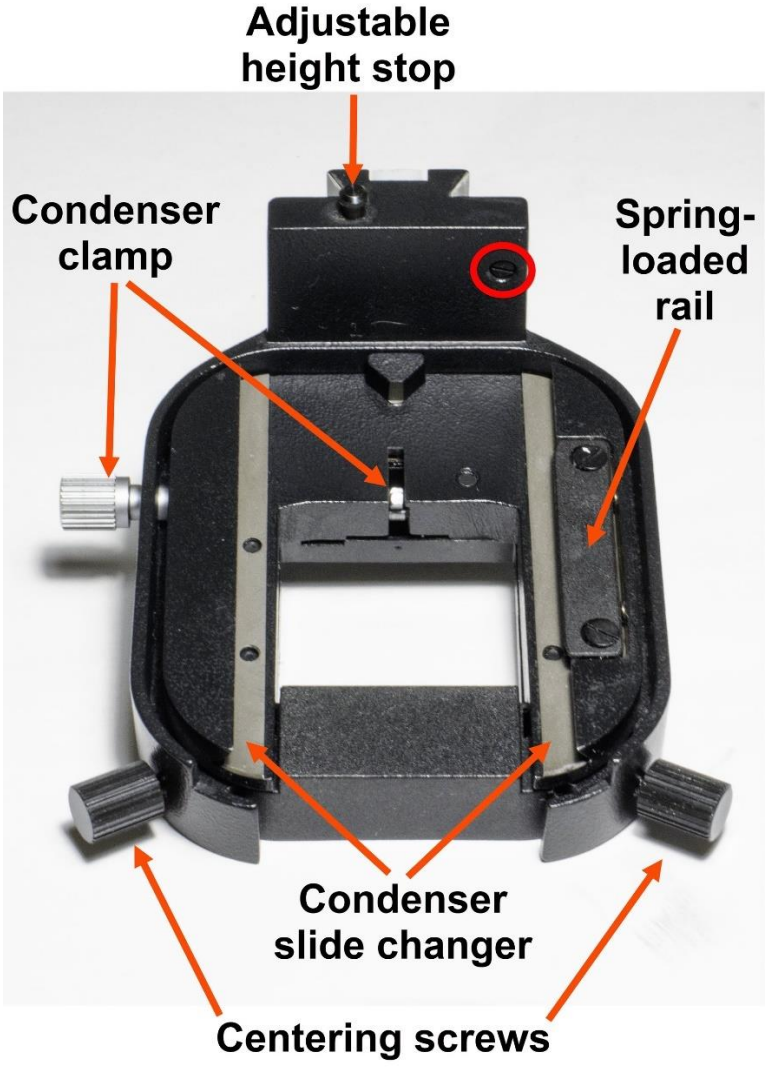

Figure 4: The Laborlux condenser holder after removal from the microscope. The stop screw that determines the maximal range of the condenser focus is labeled with a red circle.

Figure 3: The backside of the condenser holder. The knob at the bottom is for the adjustable condenser height stop. The top end of the stop rod is visible on top of the holder. The condenser focus rack is the gray, striped plastic part in the middle.

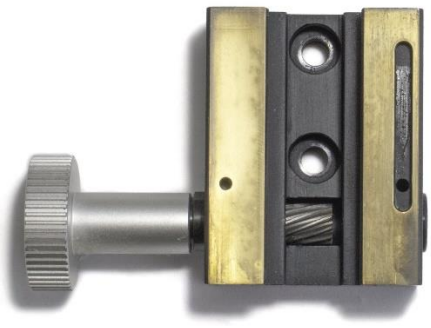

Figure 5: The condenser focus block.

Turn the coarse focus control to move the microscope stage to its highest position.

Turn the condenser focus control (a.k.a. the “condenser height adjustment”) to move the condenser holder to its lowest position.

Put the microscope on its back on the table.

Remove the stop screw indicated with a red circle in Figure 4. The tip of this screw fits into a groove (black, on the right side of Figure 5) in the condenser focus block and determines the maximal range of the condenser focus setting.

With the screw out of the way, turn the condenser focus control all the way down and then manually pull the condenser holder further down until it comes off from the dovetail mount.

The chrome plated knob on the underside of the condenser holder (Figure 3) is part of a simple mechanism allowing the user to set an upper height limit to the condenser focus control. The idea of the limit is to protect the upper lens of the condenser from getting scratched by hitting the bottom of the object glass. When the knob is turned a steel rod on the inside of the block is pushed up to protrude from the upper side of the condenser holder (Figure 3) thereby limiting how high up the condenser is allowed to move.

Remove the knob, clean it with solvent, apply some fresh grease to the threads and reattach it. Clean the steel rod with solvent and re-grease it lightly.

3. Disassemble, clean, and grease the condenser holder’s centering slide.

The condenser holder has a centering platform which allows the condenser to be optically aligned with the microscope objective with the help of two centering screws (Figure 4.) The centering platform consists of two shells (Figure 6 and Figure 7), the upper shell is made of metal and attached by screws to the bottom shell which is made of plastics. The centering platform is sandwiched over the stationary middle section (Figure 4, Figure 6 and Figure 7) and can move 3 millimeters sideways or back-and-forth on the centering slide with the help of the two centering screws. The centering screws work against a leaf spring (Figure 8) in the rear of the platform. The upper shell has a dovetail mount (the condenser slide changer, Figure 4), where the condenser is attached. A spring-loaded rail along one side of the dovetail mount helps to hold the condenser steady in place.

Figure 6: The main parts of the centering platform of the Laborlux family condenser holder viewed from the top.
From the top and down:

- *The upper shell (metal)*
- *The middle section (metal)*
- *The bottom shell (plastic)*

Figure 7:The main parts of the centering platform of the Laborlux family condenser holder viewed from the underside.
From the top and down:

- *The upper shell (metal)*
- *The middle section (metal)*
- *The bottom shell (plastic)*

Remove the centering screws (Figure 4) from the condenser holder.

Put the condenser holder upside-down on a suitable support (e.g., a plastic cup with a flat bottom turned upside-down.)

Remove the four M3x10 screws from the underside of the condenser holder (Figure 1 and Figure 2) and lift off the black, plastic bottom shell.

You will now see (Figure 8) the greased (lower) centering slide, the condenser clamp mechanism (on Laborlux condenser holders only, the Dialux family holders don't have any condenser clamp), the leaf spring which works against the two centering screws, and on the bottom shell the two centering screw receivers (small pieces of sheet metal glued to the plastic bottom shell to protect it from being worn out by the tips of the centering screws, Figure 10.)

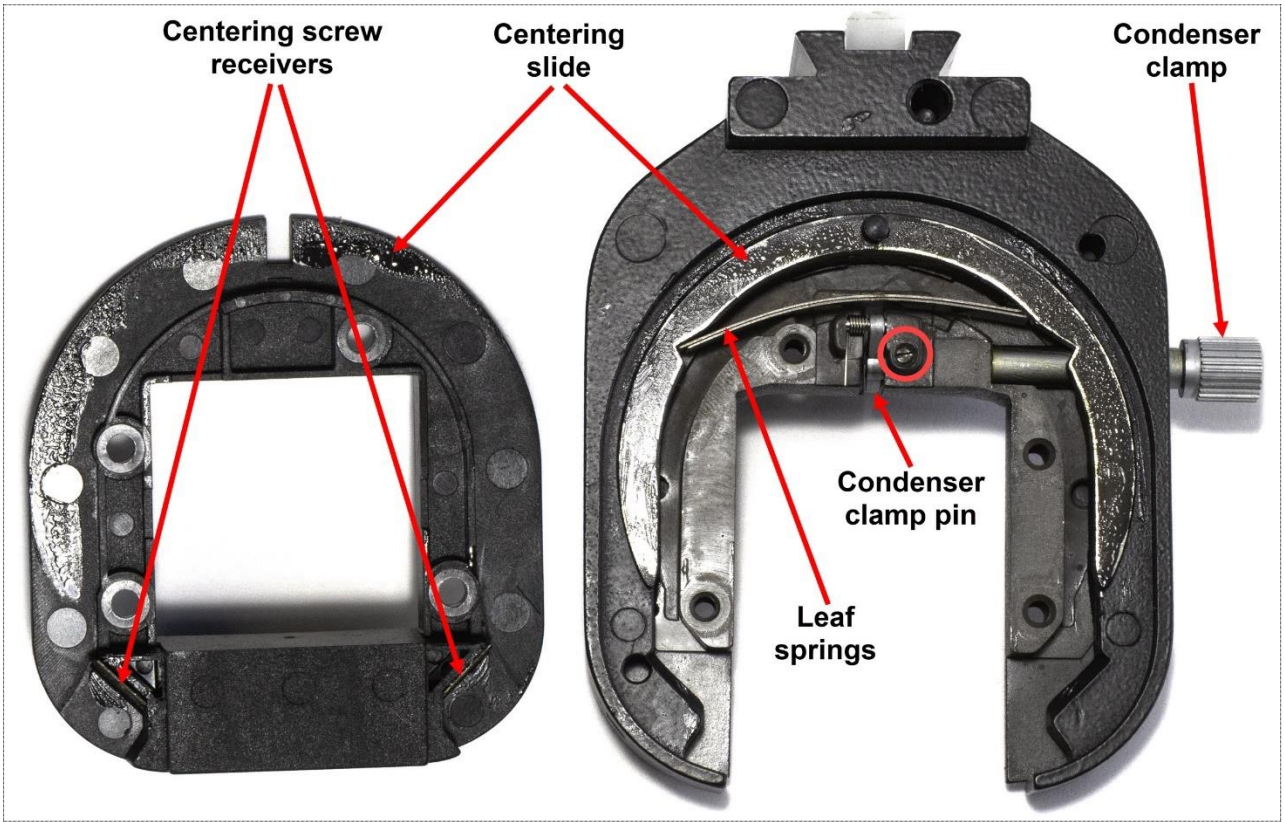

Figure 8: The bottom shell (on the left side of the image) after removal from the Laborlux condenser holder (on the right side of the image). Both parts are viewed from the underside.

As mentioned above, one of the differences between the condenser holders of the Dialux vs. Laborlux family is that only the Laborlux holders include a condenser clamp that locks the condenser to the holder. Therefore, on a Laborlux condenser holder only, loosen the screw (red circle in Figure 8, the screw may be somewhat stuck with a threadlocker) that holds the condenser clamp and pull out the clamp axle with the knob (Figure 9.) The small clamp pin (barely visible in Figure 8) will flip up because it is attached to a small spring, but it will remain safely attached in the upper shell.

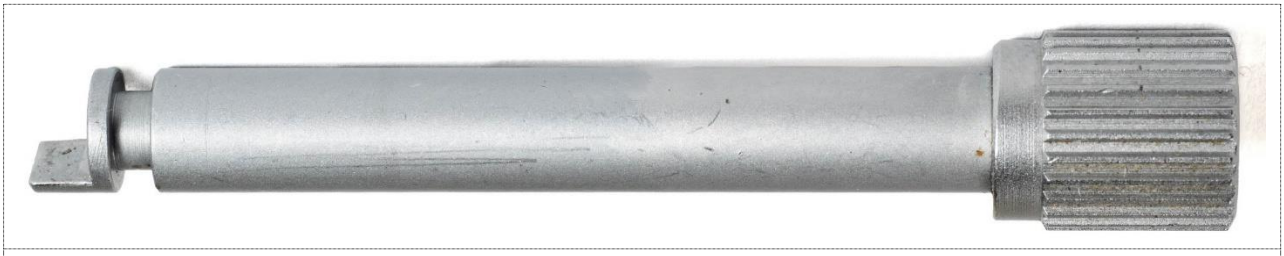

Figure 9: The removed condenser clamp (axle and knob.)

After you have opened up the centering slide just leave the leaf spring (actually two springs sandwiched together, Figure 8) where it is. Remove the upper shell (with the condenser slide changer) from the condenser holder to make the upper centering slide accessible for cleaning and greasing.

You may find that one or both of the small centering screw receivers have come loose from the bottom shell. In such cases, clean and degrease the surfaces thoroughly with solvent and reattach the loose metal receivers with epoxy glue (Figure 10.)

Figure 10: The bottom shell of the condenser holder. The centering screw receiver (a square piece of sheet metal) on the left side is missing.

Now you need to decide whether you wish to grease the centering slide surfaces or leave them ungreased.

Some parts of the condenser holder should clearly be greased, for example:

- the axle of the condenser clamp,
- the small condenser clamp pin,
- the concave side of the leaf spring (i.e., the side that pushes against the bottom shell),
- the threads of the centering screws, and,
- the contact points between the tips of the centering screws and the receivers

Greasing is however more of an open question when it comes to the slide. Advantages with greasing: Smooth movements and generally a smooth feeling; less risk that the slide gets mechanically stuck. Disadvantages: The grease may solidify due to aging and make the slide sluggish; grease tend to attract dust and dirt. Did Leitz grease the slide at manufacturing? I don't have a conclusive answer. Some of the condenser holders I have worked with appeared to have grease-free slides, other slides appeared to be covered with a whitish waxlike substance, presumably grease, but aged and somewhat hardened.

If you decide to grease the slide, apply the grease to all four surfaces of the centering slide (two surfaces on the middle section, one adjacent surface on the bottom shell, and another adjacent surface on the upper shell.

4. Reassemble the condenser holder.

Align and put together the upper shell (after greasing it, if applicable) with the middle section and put it down on the support (like the upside-down cup mentioned previously) with the upper shell downward; we are now approaching something that again will look like the part on the right side of Figure 8. Grease the condenser clamp (Figure 9) and attach it into the side of the middle section while pushing down the clamp pin against the force of its spring. The pin should be under spring tension and held down by the asymmetric tip of the clamp axle. Attach the small screw (red circle in Figure 8) that holds the clamp. Consider applying some threadlocker to the screw threads (note that threadlockers typically won't work unless the thread is clean and free from grease), alternatively add a very small droplet of polystyrene cement to the screw head to lock it. Make sure that the screw tip reaches down into the groove at the end of the clamp axle and don't tighten the screw so much that it prevents the clamp axle from turning.

We are now facing the difficult part – to align and attach the plastic bottom shell to the rest of the condenser holder. This is somewhat difficult because to provide space for the bottom shell you will need to push the moving slide against the leaf springs, and unfortunately this makes the leaf springs prone to pop out of their place. Then the leaf springs must be put back (see Figure 8 and Figure 11 for their proper position) before another attaching attempt can be done. It may take a few (or sometimes many) trials to succeed.

Important: Arrange your workspace to be clean and uncluttered to ensure that you easily can find and retrieve the leaf springs if (or rather, when) they pop out of their place and shoot away across the room. Also wear safety goggles when working with the leaf springs.

We will start with the middle section combined with the upper shell and placed on the same support as mentioned above. Put the two leaf springs in the opening between the middle section and the upper shell in such a way that the ends of the springs go all the way into the notch or corner as shown in Figure 11.

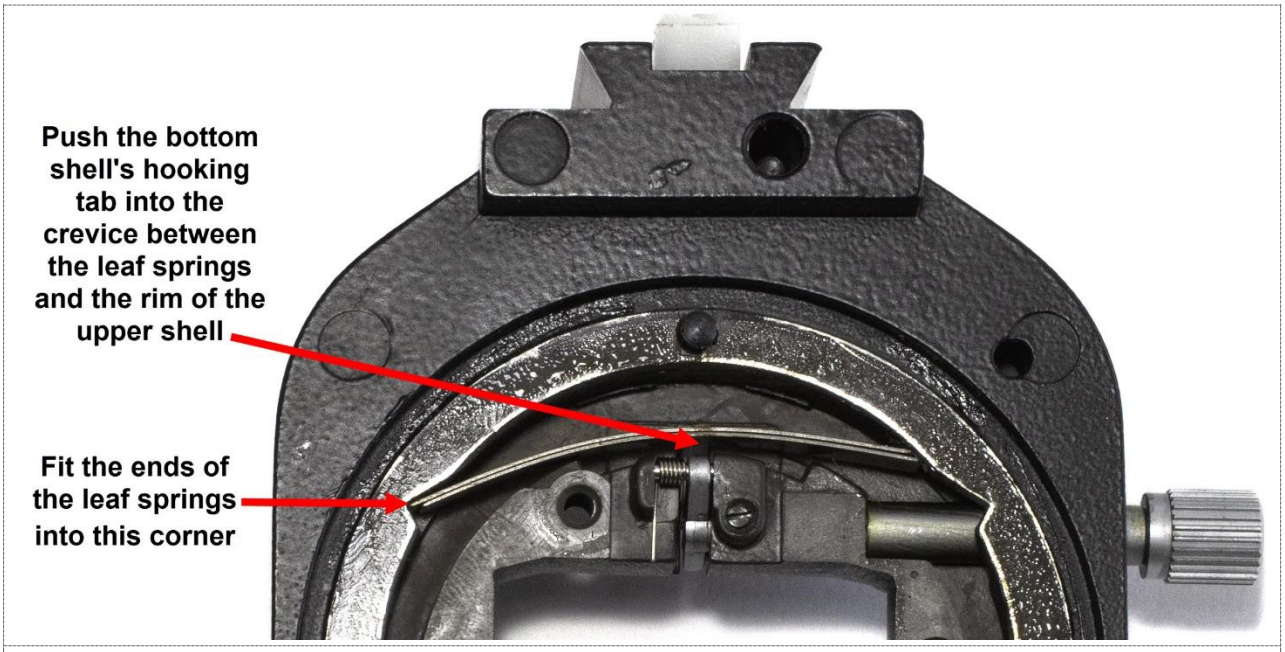

Figure 11: View of the Laborlux condenser holder just before the bottom shell is attached.

While keeping the upper shell tightly pressed against the slide of the middle section push the upper shell against the springs to open up a crevice between the springs and the rim of the upper shell (the crevice will be where the tip of the upper arrow points in Figure 11.)

Now attach the bottom shell to the condenser holder by first pushing its hooking tab (Figure 12) down into the crevice and then putting down the bottom shell onto the slide. This is challenging, as the parts easily separate or fall apart during the manipulations, and the springs tend to pop out and fly away.

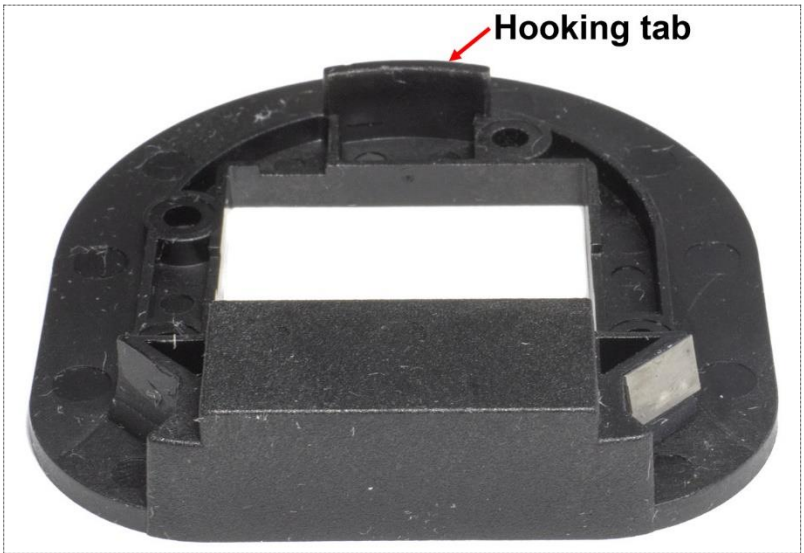

Figure 12: The bottom shell of the condenser holder.

It seems that minor shape differences have a large impact on how difficult the assembly will be. I have been able to assemble a few centering slides without too much trouble, but in one case I just had to give up. Eventually I managed by including only one of the two leaf springs – omitting one of the springs made the task considerably easier. Fortunately, the centering slide still works very well with only one spring.

Once the parts of the centering slide have been successfully combined, secure the slide with the four M3x10 screws as in Figure 1 or in Figure 2.

Check by pushing the centering slide with the fingers that it slides within the constraints of the condenser holder. If the condenser holder belongs to the Laborlux family turn the condenser clamp to check that the clamp pin moves up and down.

Clean the centering screws with solvent and apply some fresh grease to the threads. Reattach the centering screws and again check that the centering works smoothly.

The condenser holder's spring-loaded rail (Figure 4) is usually working fine even with old grease, but it can if necessary be removed, cleaned and re-greased. Remove the two screws on top of the rail to release it but be aware that the rail is under lateral tension from two small springs (and don't lose the springs.) Clean out the old grease with solvent, apply fresh grease, reattach the parts, and tighten the screws. The screws need to be attached while the rail is pressed laterally with the fingers against the springs. As this requires some force and as the rail has a rather sharp edge, it helps to wear a glove to save your fingers.

5. Disassemble, clean, grease and reassemble the condenser focus block.

The condenser holder slides vertically on a greased dovetail mount on the condenser focus block (Figure 13.) The condenser holder has a white plastic rack which engages with the block's condenser focus mechanism, basically a steel pinion attached to a 4.5 mm steel axle with a focus knob (Figure 14 and Figure 16.) The axle sits in an excentric plain bearing (Figure 17) which allows for adjustment of the tension between the pinion and the rack. After several years of use (or even worse, inactivity) the

condenser focus mechanism may be somewhat stiff or sluggish due to aged, hardened grease on the dovetail mount and in the plain bearing that holds the axle. After cleaning and greasing the control should turn smoothly again.

Remove the two M4x12 screws (with hex drives) and then remove the condenser focus block (Figure 13) from the microscope stand. There may be one or a few thin metal shims between the focus block and the microscope stand to support condenser alignment. If there are any such shims, make sure to retrieve it/them and make a note of their location. Figure 13 shows a 0.07 mm shim (to the left of the upper screw) which was found sitting at the upper screw hole. Sometimes the shims fall out before you have had any chance to determine their location; in such cases it may still be possible to infer where they were sitting thanks to the marks left on the metal surfaces (Figure 16.)

Figure 13: The condenser focus block after removal from the microscope.

Next, we will work with the condenser focus control axle (Figure 14.) Remove the chrome plated M3 screw in the center of the condenser focus knob. The inside of the knob has M4 threads reaching a few mm down. Below these threads is the tip of the condenser focus axle. The axle tip has a short internal M3 thread (Figure 15) to which the chrome plated M3 screw is attached.

Figure 14: The condenser focus axle with all parts separated.

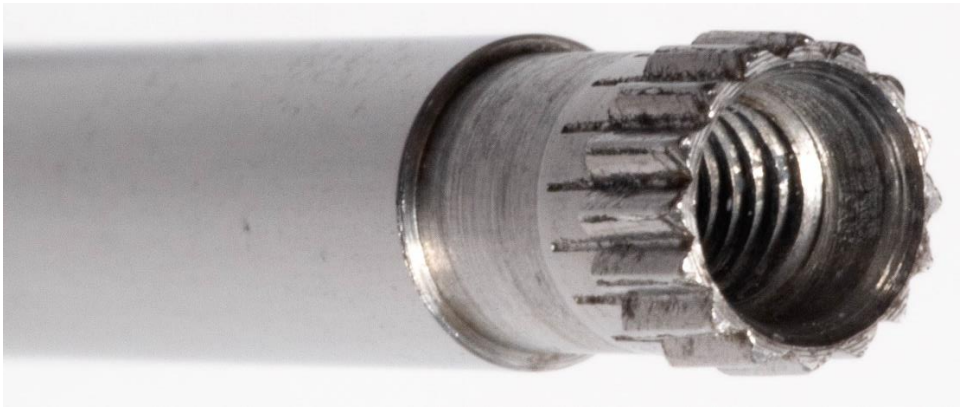

Figure 15: The condenser focus axle end which sits in the knob.

The M4 thread on the inside of the knob was apparently used for knob removal by Leitz technicians. Not knowing about the details of their procedure we will resort to a knob removal hack, the “hammer and rod’ method. Generally, this hack should only be attempted on knobs attached on very robust mechanisms. Fortunately, the condenser focus control axle is quite robust. We will need a steel rod of carefully selected dimensions: It should be at least 30 mm long, but preferably not much longer. The diameter should be as wide as possible, but not wider than it can freely fit into an M3 nut. This means maximally 2.4 mm diameter. The rod must be able to pass through the knob, through the inside M3 threads in the axle tip (Figure 15), and reach to the bottom of the axle hole without hurting the threads. I was fortunate enough to find a 0.093” (2.36 mm) steel rod in my toolbox, but the rod could also be made by cutting a piece off from a suitable drill bit or even from a round nail.

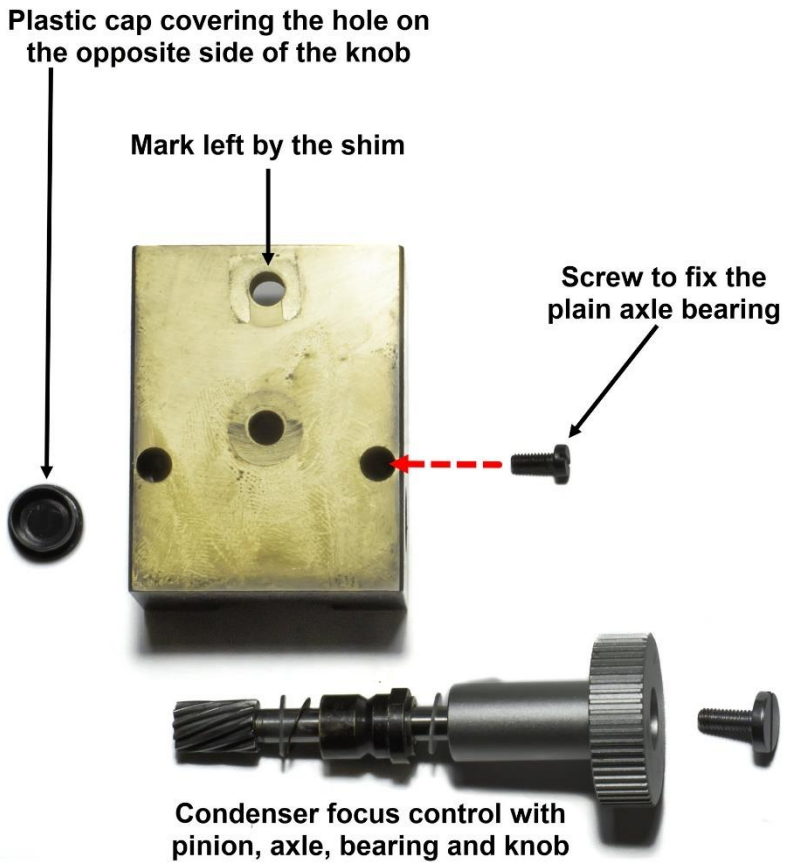

Figure 16: The condenser focus mechanism pulled out from the brass block.

Remove the condenser focus axle from the brass block by releasing the axle bearing’s fixing screw (Figure 16) accessible from the condenser focus block’s backside. Pull out the knob with the axle, bearing and pinion. The bearing may be somewhat stuck in the block, but usually releases after some pulling and wiggling.

Place the removed knob (with its axle still attached) on a suitable support with the knob facing upwards (e.g., in a vise with plastic jaw pads to protect the axle and knob). The knob should be solidly resting on the vise jaws and the axle while the pinion should freely hang downwards. Put a few drops of penetrating oil (e.g., WD-40) into the empty screw hole in the center of the knob and let it work for one or a few days. Heat the knob with an electric heat gun until it is just too warm to touch (approx. 50-60°C, or 120-140°F), but be careful not to overheat it - heat guns are quite powerful and there are a couple of possibly heat sensitive plastic washers below the knob. After the heating put the axle assembly back on the vise with the knob facing upwards. Put something soft under the vise to catch the axle when it releases from the knob (so it doesn’t fall on the floor.) Put the steel rod you manufactured all the way into the knob’s screw-opening and down into the axle end, and then tap the rod with a small hammer with a plastic head. Begin with gentle taps, tap many times, and then carefully tap harder and harder, as necessary. It may take several or many taps, but eventually the axle will release from the knob.

The parts are in order from the left to the right (Figure 14 and Figure 16):

- Axle with pinion
- Transparent plastic washer, 0.5 mm thick, i.d. 4.5 mm, o.d. 8.0 mm
- Black conical steel washer, 0.2 mm thick, i.d. 5.1 mm, o.d. 8.0 mm, with the convex side facing the brass bearing
- Plain brass bearing, with the collar facing the knob
- Transparent plastic washer, 0.5 mm thick, i.d. 4.5 mm, o.d. 8.0 mm
- Knob
- Chrome plated screw

(The plastic cap [Figure 16] that covers the hole in the condenser focus block on the opposite side of the knob doesn't need to be removed.)

Use solvent to clean the axle bearing and washers from old grease and let the parts dry.

Clean the slide of the condenser focus block ("condenser slide changer" in Figure 4.)

Grease the washers, the axle, and the inside of the bearing, but don't grease the pinion (the rack and pinion were apparently not greased by Leitz when the microscope was manufactured.) Reattach the washers and the bearing to the axle in the same way as they were before disassembly (Figure 16). Wipe off excess grease from the axle's knob end and attach the knob. Use a vise to carefully press the knob onto the axle. The knob should be pressed down onto the axle just enough to prevent any axial play (a minimal play is acceptable), but not as far as to make the axle to move sluggishly in the bearing. If overdone, you can always again use the "hammer and rod" procedure to knock it back ever so slightly. Finally attach the chromium plated screw to the knob and tighten the screw lightly. Check that the axle still rotates freely in the bearing.

Push the axle with the bearing into the brass block and attach (but don't yet tighten) the fix screw from the backside of the block.

6. Adjust the tightness of the condenser focus control's rack and pinion mechanism.

As indicated above, the tightness or the tension between the rack and the pinion can be adjusted thanks to the excentric hole in the condenser focus axle bearing (Figure 17). A 9 mm open ended wrench can be used to rotate the bearing in its hole in the condenser focus block thereby varying the distance between the rack and the pinion. The access to the two flat sides of the bearing circumference (Figure 17) is however narrow (between the condenser focus block and the condenser focus knob) why a special thin wrench (max. 2.5 mm) is required. If not possible to source, a suitable wrench can quite easily be manufactured by cutting, grinding, and filing a piece of 1.5-2.5 mm aluminum sheet metal or hard plastic. No precision is required, it only needs to have two parallel sides approx. 9.1 mm apart to fit around the bearing collar. The bearing rotates quite easily in its hole, so the wrench doesn't need to be particularly sturdy.

The tightness adjustment must be done before the condenser focus block is attached to the microscope. The reason is that after the bearing adjustment is completed, its fixing screw must be tightened, and that screw is only accessible from the backside of the condenser focus block (Figure 16.)

Use solvent to clean off any old grease from the shiny sliding surfaces of the condenser dovetail mount and then apply a new layer of fresh grease on the same surfaces. Use the wrench to turn the bearing into a starting position where the pinion is retracted as deep down as possible into the condenser focus block. Remove the stop screw (with the red circle in Figure 4) from the condenser holder and slide the entire holder carefully down on the dovetail mount of the condenser focus block* (make sure that neither the condenser holder nor the focus block is upside-down.) When the rack reaches the pinion proceed carefully by turning the control knob so the pinion gently catches the cogs of the rack. Don't force it, the rack is made of plastics and can't take much abuse. Once the condenser holder is vertically level with the focus block attach the stop screw again and tighten it so its tip sticks down into the groove in the focus block. Turn the condenser focus knob back and forth through the entire range as allowed by the stop screw. In the starting position the rack and the pinion will be somewhat separated which is apparent by some play when the knob is rotated back and forth. Use the thin 9 mm wrench to rotate the bearing until the knob play just disappears. The knob should still turn easily, but there should not be any play left through the entire condenser focus range. When the adjustment feels satisfactory, fix the bearing by tightening the fixing screw on the backside of the condenser focus block.

Figure 17: The condenser focus axle bearing. The image shows the excentricity of the axle hole and the parallel sides of the collar made to fit a thin wrench.

Loosen the stop screw (with the red circle in Figure 4) and detach the condenser holder from the condenser focus block. Attach the condenser focus block to the microscope stand with the two M4x12 screws (Figure 13), and if applicable, don't forget to put back the shim(s). Attach again the condenser holder to the focus block and tighten the stop screw.

Finally check that the condenser focusing works as desired.

* It can happen that the condenser holder is difficult to slide or even attach to the dovetail mount on the condenser focus block. It may help to carefully sandpaper the front surfaces of the block's dovetail mount to remove surface tarnish. Start by using solvent to remove any grease from the condenser focus block's dovetail mount. Put an extra fine sandpaper (for example, grit size 400) with the grit side up on a flat and even surface. Polish the front of the block's dovetail mount by rubbing it against the sandpaper on the table. After 10-15 strokes check how the condenser holder fits in the dovetail mount. Repeat the sandpapering as necessary, grease the slide when it appears that you may be close to a good fit. Don't overdo the sandpapering and check the fit often – surprisingly little grinding is required to get the slide to move smoothly.