# Leitz Laborlux S Coaxial Focus Control Maintenance Notes

## Introduction

The coaxial focus control of the Leitz Laborlux S microscope can conceptually be divided into three parts, the focus cassette (with the coarse and fine focus knobs and an internal gear mechanism), the external gear mechanism, and the focus slide (to which the microscope stage is attached.) The combined gear mechanism converts the turning of the coarse and fine focus controls into precise vertical movements of the focus slide.

## Scope

These maintenance notes describe the disassembly, cleaning, greasing and reassembly of the Laborlux S coaxial focus control. In large parts the notes should also be applicable for other contemporary Leitz Laborlux (11, 12, D, K and S models) and Biomed microscope models. Leitz Dialux 20/22, Diaplan and Aristoplan have on the other hand entirely different coaxial focus controls. Note that some of the Laborlux 11, 12 and K microscopes were offered with either coaxial focus controls or with Leitz' own special single-knob focus control.

## Grease

Selecting the optimal grease can be complicated. Without much insight about this topic, I have chosen to use Super Lube Multi-Purpose Synthetic Grease with Syncolon, NLGI grade 2, for all moving parts of the Laborlux coaxial focus control. (NLGI grade or NLGI consistency number is an international standard describing grease thickness; grade 2 is colloquially described as "soft", or similar to "tomato paste".)

## Limitations

There are a few things that you should know before you start to work with your focus control:

- If you find that some technical details of your Laborlux S microscope differ from the descriptions in these notes the reason may be that the Laborlux S microscope model underwent technical modifications and improvements during its years of production. There were also several similar Laborlux models in production, for example Laborlux 11, 12, D and K.
- Collimation is the procedure of aligning the optical axes of all optical components to have them to coincide into one common optical axis. Taking apart and maintaining the focus slide as described in these notes would in a professional setting require to be concluded by collimation and adjustment of the focus slide and the stage. Proper collimation requires training and special equipment which takes it beyond reach of the typical microscope amateur and is therefore not covered in these notes. If collimation is important to you, then you should not try to service your focus control according to these notes, or at least avoid to disassemble the stage and the focus slide.

# Maintenance Notes

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

To facilitate the work and to avoid contamination of sensitive optics, the objectives, the head with the eyepieces, and the condenser should be removed from the microscope and stored protected from dust. The stage can remain attached on the stage holder, but the condenser holder and the condenser focus control (a.k.a. condenser height adjustment) must be removed from the stage holder to gain access to the focus mechanism.

Protect the field lens in the microscope foot by covering it with a suitable lid (for example, from a food container) and tape it so it doesn't fall off.

## 2. Remove the condenser holder from the microscope.

Turn the coarse focus control to move the microscope stage to its highest position. Turn the condenser focus control to move the condenser holder to its lowest position. Put the microscope on its back on the table. Remove the condenser holder's stop screw indicated with a red circle in Figure 1. The tip of this screw fits into a groove (black, on the right side of Figure 2) 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 push the condenser holder further down until it slides off from the dovetail mount.

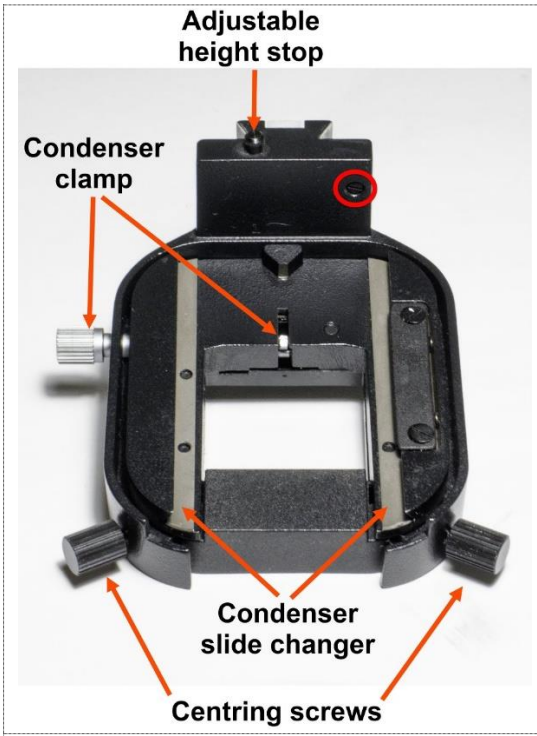


*Figure 1: The condenser holder after removal from the microscope.*

*Figure 2: The condenser focusing block and mechanism after removal from the microscope's stage holder.*

## 3. Remove the condenser focusing block and mechanism.

Remove the two M4x12 screws (with hex drives) and remove the condenser focusing block and mechanism (Figure 2.) There may be one or a few thin metal shims between the block and the

microscope stand to support condenser alignment at manufacturing. If there are any such shims, make sure to retrieve it/them and make a note of their location. Figure 2 shows a 0.07 mm shim (to the left of the upper screw) which was found to sit with the upper screw. 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 faint imprints that they leave on the metal surfaces.

## 4. Remove the stage holder from the focusing mechanism.

Remove the four screws (surrounded by green circles in Figure 3) that attach the stage holder to the focus slide. The two lower are M4x25 screws and the two upper are M4x35 screws, all with 3 mm hex drives. Refer to Appendix 1: Stuck stage holder screws if you have difficulties with releasing these screws.

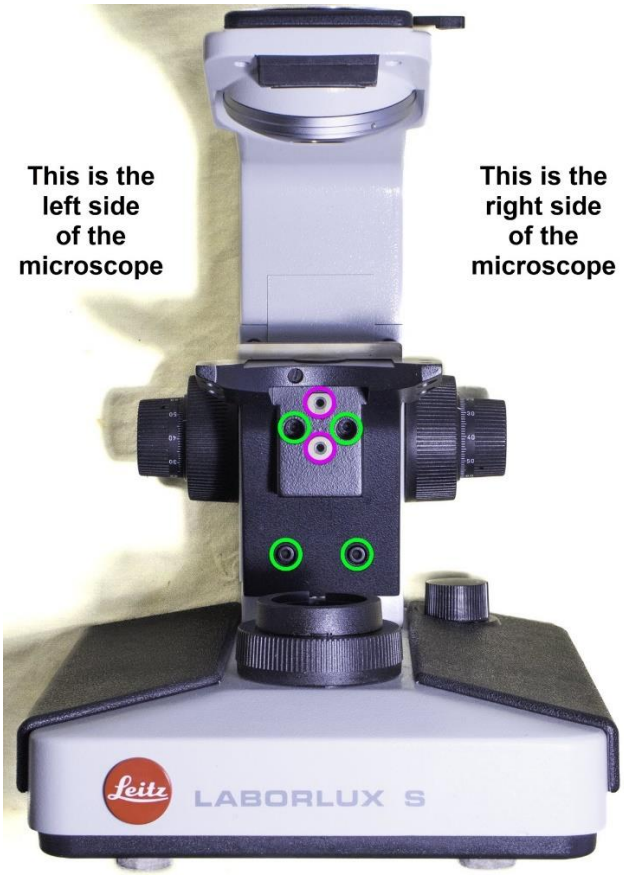


*Figure 3: The microscope with the bare stage holder. The condenser assembly and the stage have been removed. (It is however not necessary to remove the stage from the stage holder.)*

*Green circles: Screws attaching the stage holder to the focus slide.*

*Purple circles: Screw holes where the condenser focus block was attached.*

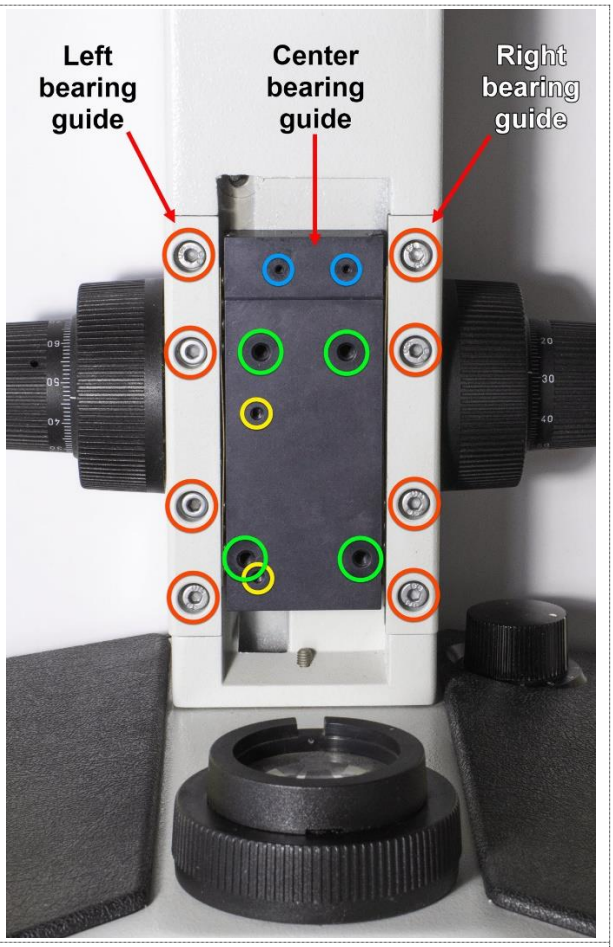


*Figure 4: The microscope's focus slide after the stage holder has been removed.*

*Green circles: Screw holes for the screws attaching the stage holder to the focus slide.*

*Blue circles: Screw holes for the screws attaching the white shield.*

*Yellow circles: Screw holes for the focus rack on the back side of the focus slide (middle bearing guide).*

*Red circles: Screws attaching the right and the left bearing guide to the microscope stand.*

With the stage holder out of the way we now have access to the focus slide (Figure 4). The focus slide consists of a vertically moving center bearing guide (black in Figure 4) enclosed between the stationary left and right bearing guides (white parts under the red circles in Figure 4.) Two linear ball bearings on each side of the center bearing guide ensure that the slide moves smoothly and without any play.

Remove the white shield (barely visible in Figure 3) which is attached with two M2x4 screws to the upper part of the focus slide (the screw holes are circled in blue in Figure 4.)

## 5. Disassemble and clean the focus slide.

Remove the left and right bearing guides that are held by 4 + 4 chromed M4x12 screws (with red circles in Figure 4.) The guides are identical so there is no need to keep track of left vs. right. Retrieve the center bearing guide and collect all parts of the two bearings (Figure 5.) The bearings are *linear crossed roller bearings,* where "crossed" means that each bearing roller's axis forms a 90° angle with its adjacent rollers (Figure 6.) Each bearing has a brass retainer with square holes for eight steel rollers. The roller diameter is 4.0 mm, and the height is 3.9 mm. The rollers run on triangular steel races that are permanently attached to the bearing guides. As indicated above, the focusing slide (i.e., the center bearing guide) moves vertically by a rack and pinion mechanism as determined by the coarse and fine focus controls. The rack is attached to the back side of the center bearing guide (Figure 4 and Figure 7.)

The rack's vertical alignment on the center bearing guide has some significance for how it fits with the external gear mechanism (Figure 7.) Unless you need to replace it (if, for example, any of its teeth are broken) it is best to leave it attached on the guide.

Use solvent (e.g., white spirit) to clean all bearing parts (races, retainers, rollers) from old grease. The rack on the backside of the center bearing guide wasn't greased by the manufacturer, so it shouldn't need to be cleaned, unless it is visibly dirty.

With the focusing slide out of the way we get our first glimpse of the focus mechanism (Figure 7.)

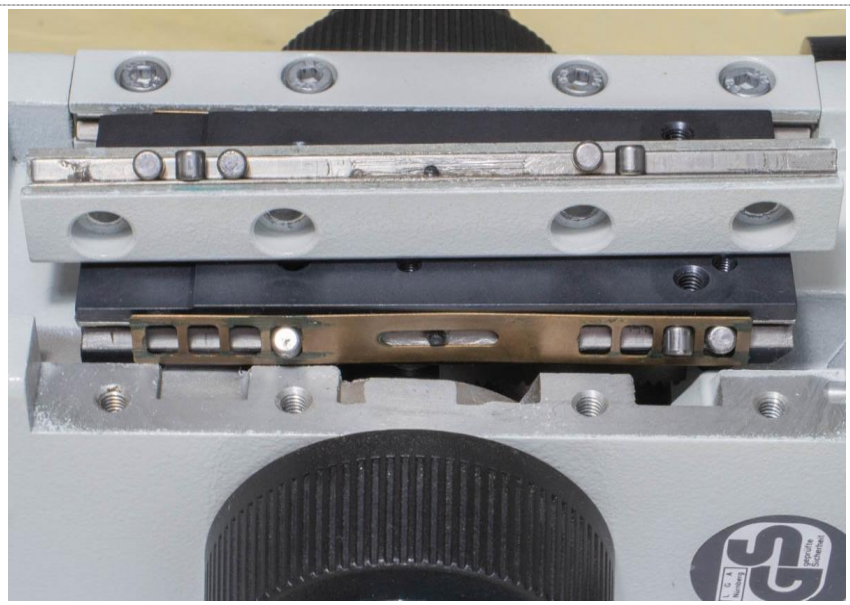

*Figure 5: The focus slide with the removed right bearing guide put on top of the center bearing guide.*

*Figure 6: Detail view of one of the linear crossed roller bearings showing how the rollers are arranged.*

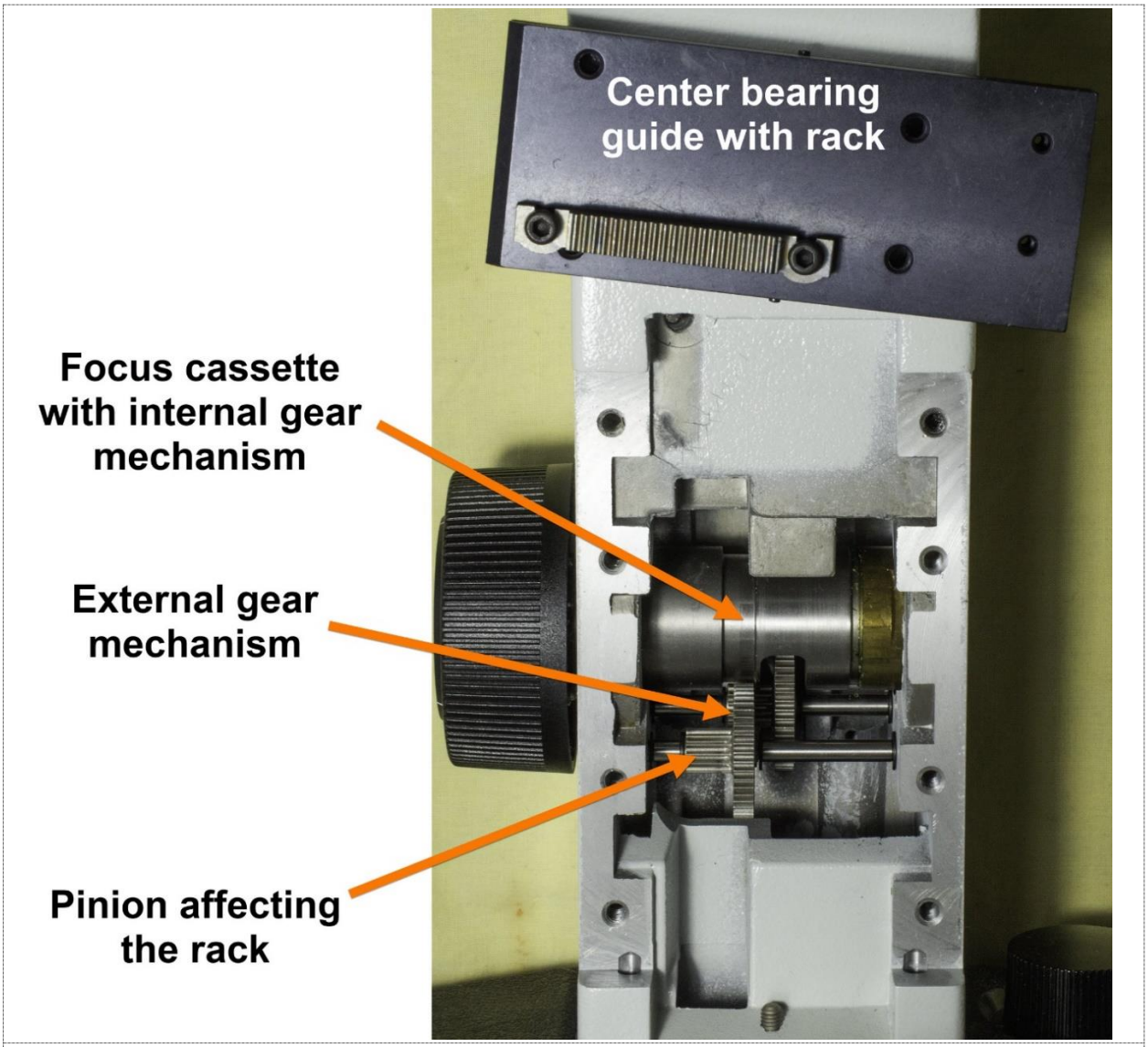


*Figure 7: The focus mechanism after the focus slide has been removed. The center bearing guide has been included on top of the image only to show how the rack is attached on its backside.*

## 6. Remove the fine focus knobs and the fine focus axle.

Loosen the tiny hex screw (using a 1.5 mm Allen wrench) deep in the side of the right fine focus knob (Figure 8). Don't remove the screw, only unscrew it by two full turns. Grab the fine focus knobs with each hand and turn them carefully in the opposite directions until the right knob releases from the fine focus axle and can be removed. Pull out the fine focus axle on the left side together with the attached left knob (Figure 8)

*Figure 8: The fine focus knobs after removal. The fine focus axle remains attached to the left fine focus knob. Note the small screw hole on the side of the right fine focus knob.*

Use solvent to remove old grease from the axle and the plastic cogwheel attached on the axle's left side.

## 7. Remove the right coarse focus knob (and grease the fine focus axle bearing.)

Remove the two long, black screws (Figure 9) that hold the right coarse focus knob attached to the coarse focus axle. The knob can now easily be removed.

*Figure 9: The right coarse focus knob after the fine focus knobs have been removed. The arrows point to the screws that attach the right coarse focus knob to the focus mechanism.*

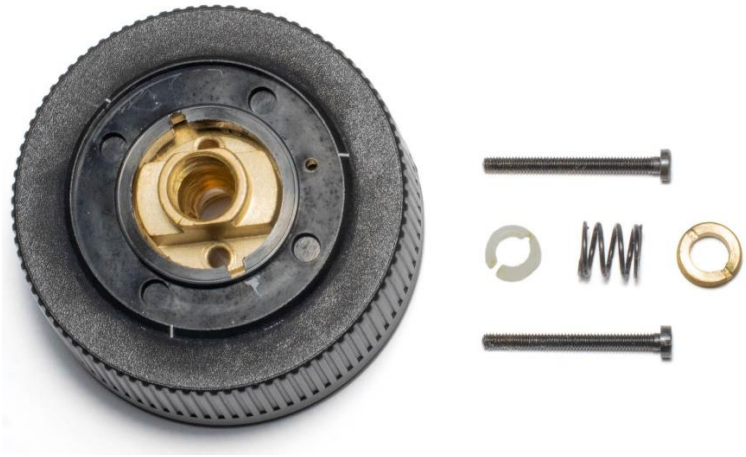

*Figure 10: The right coarse focus knob with the screws and the removed parts of the fine focus axle bearing.*

Use a wide screwdriver with a thin tip to remove the face nut (made of brass) in the center of the knob. The nut covers a spring that pushes down on a conical white plastic plain bearing around the fine focus axle (Figure 10.) The plastic bearing needs cleaning, but its removal requires gentle handling because it is fragile and may be stuck due to old, hardened grease. Remove the spring and soak the plastic bearing

for a few hours with a cotton swab drenched with solvent (white spirit.) Carefully pull out the plastic bearing taking care not to damage it. Clean it with solvent and, if necessary, scrape off any hardened grease with a toothpick or even with a steel needle. Clean the spring and the entire hole in the knob with the solvent. After drying, generously grease the plastic bearing and put it back, with the conical end facing down, into the hole in the knob. Lightly grease the spring and put it on top of the plastic bearing. Attach the face nut, but don't yet tighten it, turn it only one turn to just catch the thread.

## 8. Remove the black plastic cover from the backside of the microscope.

The black plastic backside cover (Figure 11) must be removed from the backside of the microscope so we can access the two screws that hold the focus cassette rigidly attached to the microscope stand. The backside cover is attached with two Philips screws and wedged under other black plastic covers sitting above and below.


*Figure 11: The backside of the microscope with the black plastic backside cover.*


*Figure 12: The backside of the microscope after the black plastic cover has been removed.*
*Red circles: Screws holding the focus cassette.*

Remove both Philips screws from the backside cover, grab the edges of the cover approximately 1/3 up from the bottom and carefully pull the cover outwards (towards you) while at the same time pushing it upwards. The cover will bend, so don't break it by overdoing it, but it still requires some force to get it removed. It should first come loose at the bottom and can then be pulled down from the notches holding it at the top.

This reveals the backside of the microscope stand and the two screws that hold the focus cassette (Figure 12.)

## 9. Remove the focus cassette from the microscope stand.

Remove both chrome plated M4x12 hex screws (with red circles in Figure 12) that attach the focus cassette to the microscope stand. Also retrieve the washers below the screws. With the right coarse focus knob already removed it is now easy to pull the focus cassette (with the left coarse focus knob still attached as in Figure 13) out through the left side of the microscope stand.

*Figure 13: The focus cassette after removal from the microscope. The left coarse focus knob is still attached.*

*Figure 14: The focus cassette showing the two nuts that cover the right ball bearing.*

## 10. Remove the left coarse focus knob (including the coarse focus axle) from the focus cassette.

Use two 22 mm open ended wrenches to loosen and remove the upper (locking) nut at the right end of the focus cassette (Figure 13 and Figure 14.) Regular wrenches are typically too thick to fit the lower nut's narrow flats (i.e., the parallel sides that fit into the wrench); the wrench used on this nut mustn't therefore be more than 4 mm thick.

*Figure 15: The nuts and washers removed from the right side of the focus cassette. From the right side to the left: Plastic transparent washer, wave washer, lower nut covering the bearing, upper locking nut.*

Next remove the lower of the two nuts. It covers and protects the focus cassette's right ball bearing (Figure 16.) Below the lower nut is first a steel wave washer and further down a transparent plastic washer (Figure 15) that rests on the rim of the focus cassette. Everything here is typically richly covered with grease.

With the brass nuts out of the way and not anymore holding on to the tip of the coarse focus axle (Figure 16), it is easy to just pull off the focus cassette from the left coarse focus knob and the coarse focus axle. This leaves the left focus knob with only the base plate + coarse focus axle still attached - Figure 17 shows the knob viewed from the outside, and Figure 19 shows the knob viewed from the inside.

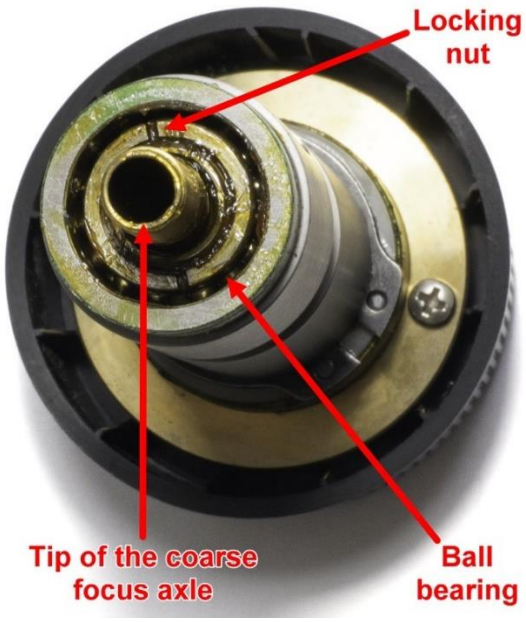


*Figure 16: The ball bearing on the right side of the focus cassette viewed after the covering nuts and washers (Figure 15) have been removed.*

*Figure 17: The left coarse focus knob viewed from the outside.*

The only loose part between the left knob and the focus cassette is a white plastic washer that sits on the snap ring (Figure 18) at the left end of the cassette. One side of the washer has a small pin that fits into one of the holes in the snap ring. The washer is thoroughly greased because its other side serves as the sliding surface (as a plain bearing) between the stationary cassette and the left coarse focus knob's base plate (Figure 19.)

*Figure 18: The left end of the focus cassette after it has been pulled off from the left coarse focus knob. The white plastic washer is attached to the snap ring.*

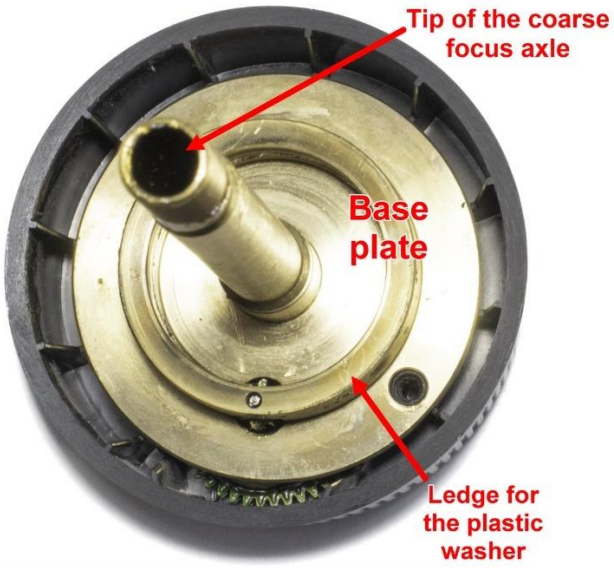


*Figure 19:The removed left coarse focus knob with the base plate + coarse focus axle still attached.*

*Figure 20:The left coarse focus knob viewed from the inside. The fine focus gear wheel (brass) is now accessible after the base plate with the coarse focus axle (Figure 19) has been removed.*

## 11. Disassemble the left coarse focus knob, and clean and regrease the fine focus gear wheel in the knob.

From the inside of the left coarse focus knob remove the two Philips screws that hold the base plate + coarse focus axle attached (Figure 16 with one of the screws still attached, Figure 19 with the screw removed.) Pull out and remove the axle + base plate from the knob to make the fine focus gear wheel accessible for cleaning (Figure 20.)

Use solvent to clean the fine focus gear wheel and the inside of the knob from old grease. If the microscope hasn't been maintained, the old grease may have polymerized and reacted with the copper from the brass to form hard green crusts on the sides of the gear wheel and between the gear teeth – in such cases it may be necessary to scrape off the deposits with a steel needle or a scalpel. Once the wheel has been cleaned, generously apply grease (Super Lube Multi-Purpose Synthetic Grease with Syncolon, NLGI grade 2) to the teeth and to the pins at the ends of the gear wheel. Put back the gear wheel into the knob, attach the base plate/coarse focus axle and secure it with the two Philips screws. Check that the fine focus gear wheel turns freely.

## 12. Disassemble and clean the focus cassette, the coarse focus gear and both ball bearings.

To disassemble the focus cassette and its internals the locking nut (Figure 16) that also serves as the outer race of the right ball bearing must be removed. The locking nut is however secured with a threadlocker. Soften the threadlocker by putting the focus cassette with its right side (the bearing side) down into a vial with an approximately 5 mm layer of acetone. Cover the vial with aluminum foil to prevent evaporation (acetone is volatile and very flammable) and leave it soaking over the night to soften the threadlocker.

Use a steel needle to scrape off as much as possible of the visible threadlocker from the thread. Clamp the large cogwheel on the left side of the focus cassette (Figure 18) in a vise provided with rubber lined jaws to protect the teeth. (Or use an alternative setup, most importantly protect the teeth.) Use a lens or camera spanner (Figure 21) to loosen the nut. Screwdriver-like tips (as in Figure 21) are in this case much better than the more common pointed tips, but make sure that the tips fit well into the locking nut's slots. Be careful not to compromise the nut's slots by slipping which easily can happen by using too much force and/or by wiggling with the spanner.

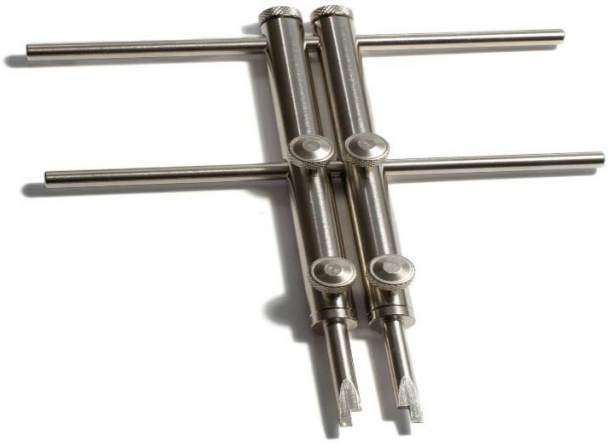

*Figure 21: A lens/camera spanner.*

If the nut appears too difficult to remove, either try to soak the nut in acetone for a longer time or use a heat gun to soften the threadlocker by warming the locking nut (but first make sure that all acetone has evaporated from the cassette and work a safe distance away from any acetone source.)

After having the nut removed, the right ball bearing is accessible with its 16 pcs of 3.0 mm bearing balls resting in lots of old grease. Collect the balls and put them in a vial for cleaning with solvent (white spirit.)

*Figure 22:The right side of the focus cassette after the right ball bearing has been removed. The ledge on the inside of the cassette is the bearing's inner race.*

*Figure 23:The left side of the focus cassette after the left ball bearing has been removed. The ledge on the inside of the cassette is the bearing's inner race.*

*Figure 24: The removed coarse focus gear. The curved surface just below the cogwheel is the outer race of the left ball bearing.*

Release the cogwheel from the vise. Grab the cogwheel with your fingers and pull it together with the attached coarse focus gear out from the cassette (Figure 24.) This opens up the left ball bearing – collect all of the 16 bearing balls and put them into the same solvent vial as mentioned above. The balls are of the same size as the balls from the right ball bearing.

Use solvent (white spirit) to clean all bearing parts and all surfaces from old grease (Figure 22, Figure 23 and Figure 24.) Wipe the bearing balls dry with a lint free microfiber cloth (don't use paper towels; these leave lots of paper fibers that strongly attach to the surfaces of the balls.)

This far, the coaxial focus control has been completely disassembled and cleaned. The focus cassette has been picked apart as outlined in Figure 25.


*Figure 25: A simplified outline of the parts of the coaxial focus control. When assembled, all parts are coaxially arranged.*

## 13. Grease and reassemble the focus cassette with the coarse focus gear and the ball bearings.

Push the white plastic washer tightly on the snap ring on the left side of the now empty focus cassette (compare with Figure 18.) Make sure that the small washer pin is completely inserted into one of the snap ring holes.

Next, we need to cover the thread on the threaded end of the coarse focus gear. This is necessary because we will later apply a threadlocker to it, and the threadlocker may not work properly if the

thread catches any grease when the coarse focus gear is inserted into the focus cassette. Make sure that the thread at the end of the coarse focus gear is clean (i.e., entirely free from grease) and dry, and protect it by wrapping it with aluminum foil. Let the foil reach 2-3 cm above the end and twist the foil into a tip so it doesn't get caught when the gear is inserted into the focus cassette.

Apply fairly generous amounts of grease (Super Lube) on the inner races of both ball bearings (on the "ledges" in Figure 22 and Figure 23.)

Put the empty focus cassette on the table with its left side up (i.e., the side with the snap ring.) Use forceps to add 16 bearing balls to the greased race and push the balls down into the grease to make sure that they don't fall off. Push the coarse focus gear all the way down into the focus cassette to join the bearing races. Hold with your fingers the coarse focus gear firmly attached to the cassette, turn the cassette upside down and put it on the table, now with its right side up. Carefully remove the aluminum foil from the coarse focus gear's thread making sure that the thread doesn't get contaminated by grease. Again, use forceps to carefully add the remaining 16 bearing balls to the greased race and push the balls down into the grease.

Hold the focus cassette horizontally and apply fresh threadlocker (for example, Blue Loctite or Green Loctite) to the thread on the end of the coarse focus gear, but be careful to avoid getting threadlocker into the ball bearing. Attach the locking nut (Figure 26) to the thread of the coarse focus gear and using the lens/camera spanner (Figure 21) screw it down until its underside meets with the bearing balls. Adjust the tension over the ball bearings by tightening or loosening the locking nut. Tighten the nut until rotating the coarse focus gear barely begins to feel strained, and then loosen the nut very slightly, perhaps 1 mm at the circumference. Leave the threadlocker to cure for at least 24 hours. If, after completed curing, there is any excess threadlocker on the surface of the locking nut (as the Blue Loctite in Figure 26) then wipe it off with cotton swabs. Note that the threadlocker only cures under oxygen deficiency, i.e., only where it has penetrated the thread, so it is normal to find that the threadlocker on the surface of the nut hasn't cured.

*Figure 26: The right side of the focus cassette with the ball bearing assembled and freshly applied threadlocker (blue.)*

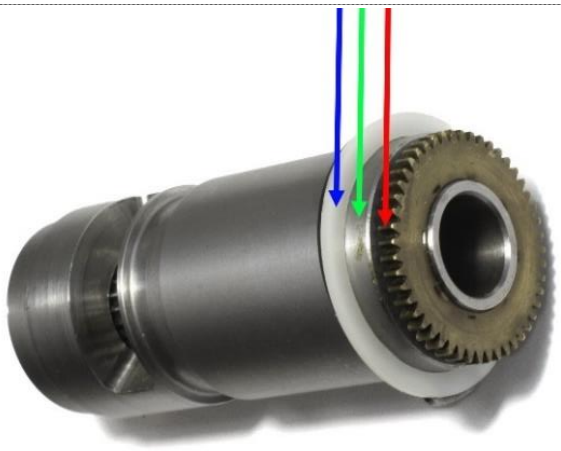

*Figure 27:The left side of the focus cassette. The arrows show the surfaces that need grease.*

Apply grease (Super Lube) generously to the large cogwheel that now sits on the focus cassette's left side (red arrow in Figure 27.) Also apply some grease on the free surface of the white plastic washer (blue arrow in Figure 27) and on the left end of the focus cassette (green arrow in Figure 27) sticking out

just under the white washer. Push the left end of the cassette over the coarse focus axle and all the way down against the left coarse focus knob (assuming that the coarse focus axle as attached to the left coarse focus knob.) Check that the large cogwheel on the end of the cassette properly catches the small cogwheel in the knob.

Apply grease (Super Lube) to both sides of the transparent plastic washer and the wave washer that were removed from the right side of the focus cassette (Figure 15.) Put first the plastic washer on the rim on the right side of the focus cassette and then the wave washer. Grease the inside of the lower nut (Figure 15) and screw it down on the threaded end of the coarse focus axle until you just can feel that the wave washer starts to compress. When this happens, the slit indicated with a green arrow in Figure 28 will be approx. 2-3 mm wide. Tighten the lower nut one more full turn and then attach the upper locking nut (Figure 15.) Tighten the locking nut with the thin 22 mm open ended wrenches, but don't overtighten. Hold the focus cassette with one hand and rotate the coarse focus knob with the other hand to check that it rotates freely. The coarse focus gear should not rotate (look at the pinion in the opening on the side of the cassette) with the coarse focus knob, but you should see that the large cogwheel (Figure 20) visible from the outside of the knob (Figure 17) quickly rotates. Next, rotate the large cogwheel only with your finger and check that the coarse focus gear slowly rotates.

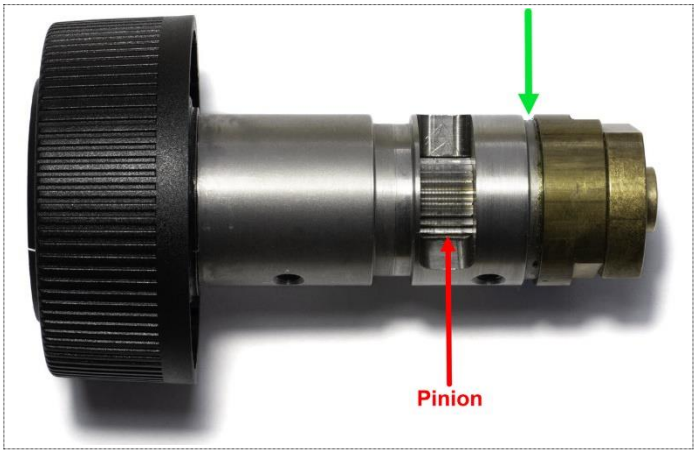


*Figure 28: The focus cassette after its right side has been capped.*

## 14. Attach the focus cassette to the microscope stand.

Note that grease should not be applied on any parts of the external gear mechanism (Figure 7.)

Insert the focus cassette into the microscope through the opening in the microscope stand's left side. Align the cassette's pinion (Figure 28) with the external gear mechanism (Figure 7), attach the cassette (Figure 12) with the two M4x12 hex screws (together with the washers) and carefully tighten the screws thoroughly. Rotate the cogwheel inside the left coarse focus knob (Figure 17) with your finger and check that the external gear mechanism rotates.

Attach the right coarse focus knob (Figure 9.) The plastic plain bearing and the spring inside the knob (Figure 10) have already been cleaned, re-greased and assembled in the knob, but check that the face nut is only loosely attached and not tightened. Attach the left fine focus knob together with its fine focus axle (Figure 25) by pushing it from the left side through the center of the focus cassette. Wipe off any grease from the tip of the fine focus axle that sticks out from the right coarse focus knob. Tighten the face nut (Figure 10) until its upper surface is even with the surrounding brass rim. Attach the right fine focus knob making sure that its locking screw aligns with the flat surface on the end of the fine focus axle. Turn the coarse focus knobs and the fine focus knobs to verify that the focus mechanism appears to work.

Put back the black plastic backside cover on the microscope (Figure 11.) Push its upper edge up into the slots under the black plastic cover that sits on the top of the microscope arm and then bend the

backside cover as required to push its lower edge under the plastic cover on the backside of the foot. Secure it with the two black Philips screws.

### 15. Assemble the focus slide.

Put the microscope on its back on a table.

Apply a thin layer of grease (Super Lube) on both races on the center bearing guide (Figure 4.) Apply a thicker layer of grease on the races of the left and right bearing guides. It should be enough grease to keep the bearing rollers in place during assembly of the focus slide. Grease both sides of the bearing retainers (Figure 5 and Figure 6.)

With the races of the left and right guides facing up put the retainers approximately in the middle of each race and push them down to attach them to the greased races. Use forceps to put the bearing rollers into the retainer holes so each roller's axis forms a 90° angle with its adjacent rollers (Figure 6.) Push down the rollers into the holes to make sure that the grease will keep them in place.

Put the left guide into its place on the microscope stand. Be careful not to lose any of the rollers. Attach the left guide with only the two outer M4x12 screws, but don't yet tighten the screws. Attach the middle guide by holding it lightly tilted and pushing it against the left guide to join the races of the left bearing. Carefully lower the middle guide's right side until the rack on the backside rests on the corresponding pinion of the external gear mechanism. Make sure not to allow the bearing races to come apart.

Attach the right guide to its place on the microscope stand and press it against the middle guide's right side to join the right bearing. Attach the left guide to the stand with only the two outer M4x12 screws, but don't yet tighten the screws. Now the slide is safe from coming apart and losing the rollers. Attach the remaining screws to the left and right guides. Apply light pressure across the slide with your fingers on the outsides of the left and right guides and successively tighten all 8 screws. Do your best to align the focus slide as vertically as possible. The tightness you have applied over the slide should be enough to avoid any lateral play, but not enough to inhibit the slide's vertical movement.

Attach the white shield to the upper end of the center bearing guide (Figure 3 and Figure 4.)

### 16. Final touches.

Attach the stage holder to the slide (Figure 3 and Figure 4.) Before tightening the screws try to align the stage holder's sides as parallel as possible with the sides of the microscope arm.

Attach the stage to the stage holder. Don't forget to include any shims, if applicable. Before tightening the screws push the stage so its backside is in close contact with the edge of the stage holder.

Attach the condenser focusing block (Figure 2) to the stage holder; the condenser focus knob should be on its left side. Don't forget to include any shims, if applicable. Before tightening the screws try to align the condenser focusing block so it is aligned as vertically as possible.

Apply grease to the slide on the condenser focusing block and to the slide on the backside of the condenser holder (Figure 1.) Move the microscope's coarse focus control to its highest position. Attach the condenser holder by sliding it into the condenser focusing block from below while making sure that the pinion of the condenser focusing control gently catches the rack on the backside of the condenser

holder. With the condenser holder halfway up in the condenser focusing block attach the small stop screw (with red circle in Figure 1) that limits the condenser focus range.

Remove the temporary protective cover from the field lens in the microscope foot and put back the microscope's head, eyepieces, and objectives.

# Appendix 1: Stuck stage holder screws

The stage holder is attached to the focus slide with four long M4 hex screws (Figure 3) that require a 3 mm hex key for removal. Occasionally these screws may be stuck and difficult to remove. Typically, in such cases one would first try to apply some penetrating oil. If that doesn't help, the next step would be to use pliers to increase the torque over the key. With some luck the pliers may fix the issue, but after all, a 3 mm hex key and an M4 screw both have their limits, and there is a risk that the added torque may break the key or, worse, strip the hex corners on the inside of the screw head.

A safer and very efficient method is to remove the stuck hex screw with a special hex screw extractor (Figure 29) that can be used with a regular ¼" socket wrench. The tip of the screw extractor is slightly tapered and cleverly twisted so the harder you turn it to release the screw, the deeper it digs down and bites into the screw head. The screw extractor is very sturdy, so if the screw after all won't budge, then the high torque may instead break either the screw body or the screw head.

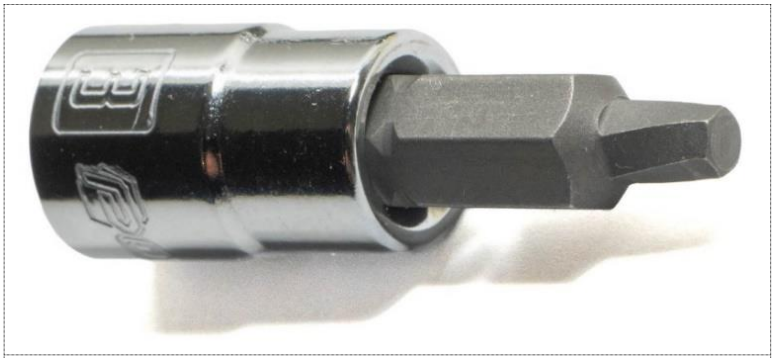

*Figure 29: A 3 mm hex screw extractor bit.*