Leitz Periplan GF 10x M Eyepiece Maintenance

Introduction and Scope

These maintenance notes cover the disassembly and basic maintenance of a Leitz Periplan GF 10x M eyepiece (Figure 1 and Figure 2.) This is an eyepiece with the common 23.2 mm barrel diameter intended for Leitz microscopes with 170 mm mechanical tube length. “Periplan” indicates that the eyepiece is designed to correct residual chromatic aberration when used with high-end Leitz objectives, “GF” stands for the German word “Groβfeldokular” (Eng. “widefield eyepiece”), 10x is the eyepiece’s magnification, and “M” indicates that it has a focusing eyelens and a graticule mount (presumably M stands for “Messung”, or “measuring” in English.)

Figure 1: The Leitz Periplan GF 10x M eyepiece. View from the top.

Figure 2: The Leitz Periplan GF 10x M eyepieces. The focusing eyelens in its most extended (left) and most contracted (right) setting.

It’s important to understand that Leitz Periplan eyepieces were manufactured for a long period of years where they underwent many design variations, both internal and external. The naming of the eyepieces only gives a few clues to their true nature, one has to rely on sometimes subtle external design details to guess where the eyepieces belong in the Periplan production timeline. I haven’t seen much information on the Internet about this, but I believe that it is an important topic for anyone interested in matching eyepieces with microscopes from the “Periplan era”, and I hope that some day someone will be able to provide some practically usable guidelines. Until then, peruse these maintenance notes with the understanding that you may find out that the Leitz Periplan GF 10x M eyepiece that you have on your table looks different than what is described in these maintenance notes. On the other hand, although

these maintenance notes specifically cover the Leitz Periplan GF 10x M eyepiece, the procedures should be at least partially applicable for other contemporary Periplan eyepieces.

Here are some maintenance tasks that could be required for a Periplan GF 10x M eyepiece:

1. **Replacing a graticule or inserting a new graticule.** The M type eyepiece has a holder for a 17.5 mm graticule situated at the same level as the internal eyepiece diaphragm. Graticules are available with several different engraved patterns or inscriptions, e.g., concentric circles, grids, crosshairs, measuring scales, etc.
2. **Cleaning and re-greasing the eyelens focusing mechanism.** The eyelens focus is adjusted by turning the eyepiece front which moves on a greased helicoid thread. The eyepiece is today not far from half a century old, and it should not be a surprise that the grease may have hardened and made it difficult or even impossible to turn the focusing ring. The only remedy is to disassemble the focusing mechanism and clean and re-grease the thread.
3. **Cleaning the outer lens surfaces.** This important task will not be covered here, refer to the many detailed lens cleaning instructions available on Internet.

Figure 3 illustrates the eyepiece parts after disassembly. Figure 4 indicates how and where the various threads are assembled.

Figure 3: Exploded view of the Leitz Periplan GF 10x M eyepiece.

In the microscopy literature it is often, and with good reasons, advised against disassembling eyepieces and objectives – this is to avoid that the internal lens surfaces inadvertently get contaminated or compromised. The work described in these maintenance notes however requires that the eyepieces indeed are opened. Therefore, while working with your eyepieces be very mindful to uphold clean working routines.

Releasing Stuck Threads

A typical difficulty during eyepiece disassembly is that any of its threads may be stuck. After unsuccessfully (due to slipping) having tried to release a thread with the fingers, it is tempting to turn to stronger measures, like holding the eyepiece with adjustable pliers or in a vise. This comes with two caveats. Firstly, the eyepiece must be carefully protected from ugly surface damage caused by the metal teeth of

the pliers or the vise. Secondly, by forcefully squeezing the eyepiece barrel with pliers or between vise jaws the barrel is forced into a slightly oval shape which will make the threads to stick even harder.

The finger grip can be improved by wrapping each of the eyepiece parts in approx. 1-3 mm thick rubber sheets or strips. Avoid silicone rubber, which is slippery. Suitable rubber sheets can be cut from rubber pads that are used to open can lids and available in kitchen utensil shops. The rubber sheet will prevent the fingers from slipping on the metal surfaces and allow more force to be applied to release the thread.

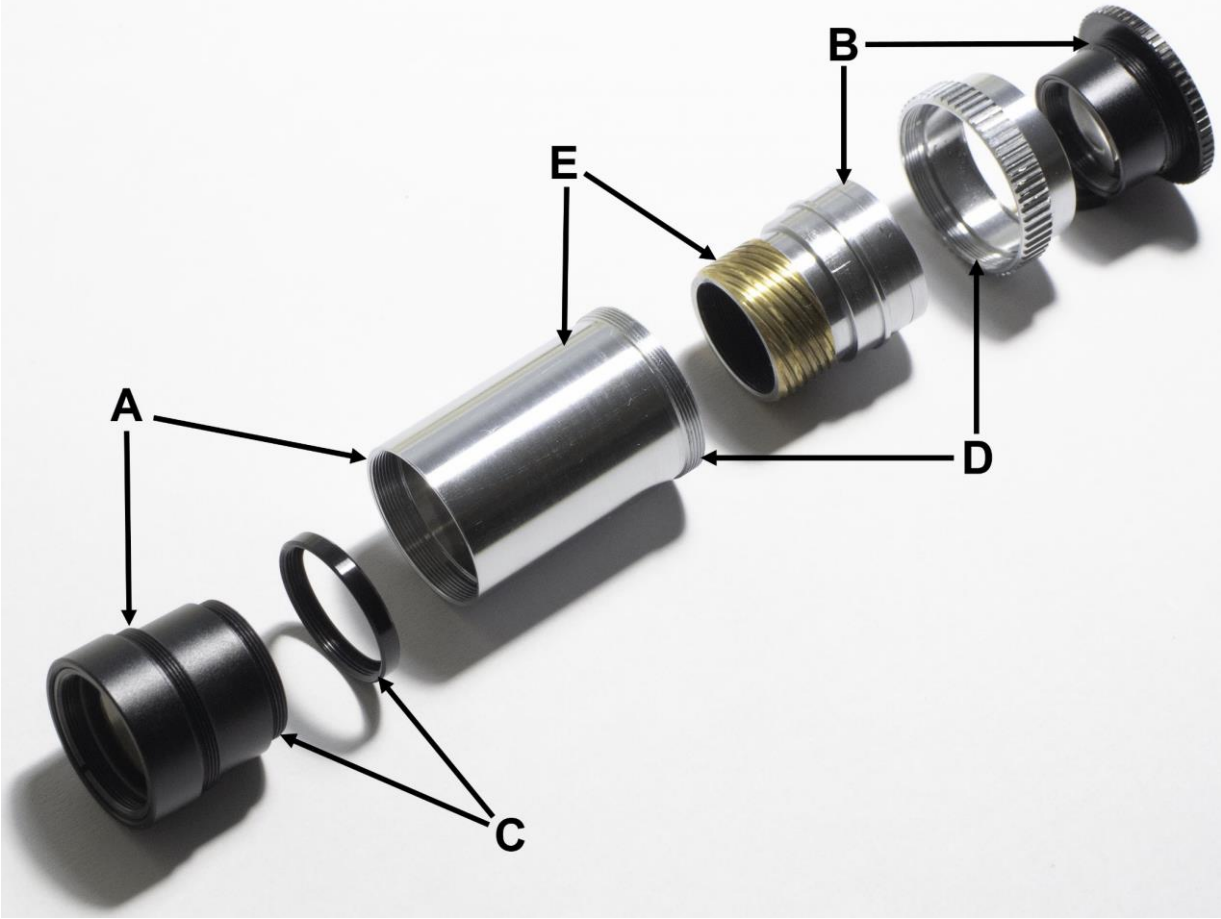

Figure 4: Another exploded view of the Leitz Periplan GF 10x M eyepiece. The letters indicate where the various threads belong.
A = The field lens assembly → the eyepiece barrel's underside
B = The eyelens assembly → the eyelens focusing tube
C = The graticule holder ring → the graticule holder end of the field lens assembly
D = The locking ring for the focusing mechanism → the eyepiece barrel's upper side
E = The eyelens focusing tube's helicoid thread → the inside of the eyepiece barrel's upper side

If the use of pliers or a vice becomes necessary, the affected eyepiece parts must be protected with rubber sheets, preferably vulcanized rubber which is be more resistant to breakthrough from the teeth of the pliers or the vise. Alternatively, a PVC hose can be cut into a 5-10 mm piece and wrapped around any sensitive eyepiece part - although PVC hoses are soft, they are surprisingly resistant to breakthrough. If the diameter of the hose piece is too small for the eyepiece, then cut up its side so it can fit the larger diameter. The disadvantage with using pliers and/or a vise is that the extra force now may break the eyepiece before the thread releases.

Another remedy is to put the unrelenting parts in a freezer for a few hours and then try to release the stuck thread. Alternatively, one could carefully heat the parts with an electric heat gun. Avoid however to use cold or heat on parts that contain lenses, i.e., on any of the field lens or eyelens assemblies.

On the Internet one can find instructions for a clever homemade non-marring clamp that can be tailored for various microscope objective and eyepiece sizes (Carl Hunsinger, Freeing Spring-Loaded Tips and Cover-Slip Correction Collars of Olympus LB Objectives, Appendix 1.) Such clamps, particularly if lined with a rubber sheet, are gentle to the surface of the objective/eyepiece and provide a more even grip around the barrel which prevents it from being forced into the undesired oval shape.

A decent alternative to Hunsinger's clamp is to use a strap wrench (Figure 5.) These wrenches are often used to release pipes or engine oil filters; for use with the eyepiece, you should purchase a strap wrench of the smallest size that you can find. Actually, you will need two.

Figure 5: A small strap wrench with the strap tightly wrapped around an eyepiece.

About Grease

The only part of the Periplan GF 10x M eyepiece that needs lubrication is the focus control's helicoid thread (Figure 11 and Figure 12.) Because of the proximity to the eyepiece's lenses, it is necessary to select a grease that doesn't emit any semi-volatile compounds that with time could form a hazy film on the lens surfaces. Several special "helicoid greases" are available that are tailored for optical helicoid threads. Helimax-XP, by μMicroLubrol, is often mentioned on Internet; it provides a very smooth and pleasant focus control that is desirable on, for example, telescopes and camera objectives. For the eyepiece focusing I however prefer to use a thicker helicoid grease that yields more resistance to avoid inadvertent changes during routine microscopy. You will need to decide which grease thickness works best for you.

Apply helicoid grease very sparsely on one of the helicoid threads. Turn the focus control back-and-forth several times to distribute the grease evenly and to check that the control's smoothness is to your liking.

Replacing or inserting a new graticule

The Leitz Periplan GF 10x M eyepiece contains a mount that fits a 17.5 mm graticule.

Avoid getting dust into the eyepiece. Also avoid getting fingerprints or dirt on any exposed lens surfaces. Using disposable nitrile rubber gloves may be a good idea during critical work moments.

1. Loosen and unscrew the field lens assembly from the bottom of the eyepiece (thread A in Figure 4, and Figure 6.)

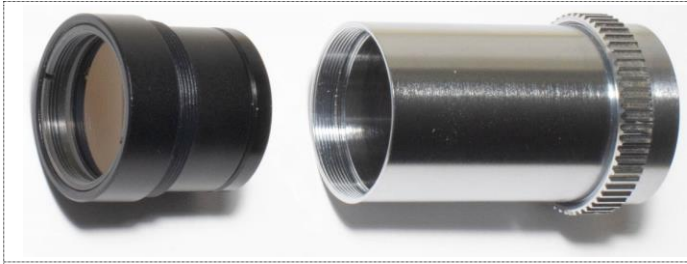

Figure 6: Removal of the field lens assembly.

2. Loosen and unscrew the graticule holder ring from the field lens assembly (thread C in Figure 4.) Be careful not to lose the graticule (if one is present.)

3. Remove the old graticule (if one is present) from the graticule holder (red arrow in Figure 7) at the upper end of the field lens assembly. Before removing it take a note of which side of it is facing upwards - this is important to know when it is time to put back the graticule again. The graticules typically have different upper and lower faces (one is usually thicker than the other when viewed from the side.) Only for a graticule with numbers or letters it will be immediately clear whether it has been attached correctly or not.

Figure 7: The graticule holder and the graticule holder ring from the field lens assembly. The red arrow points to the circular ledge where the graticule is positioned.

4. Check that the new graticule is clean and put it into the holder ledge (red arrow in Figure 7) on the field lens assembly. Make sure that the graticule's designated upside is facing upward. Also make sure that the graticule is properly seated and centered in the ledge.

5. Attach the graticule holder ring to the field lens assembly. Tighten it lightly.

6. Check that the graticule still is clean. Reattach the field lens assembly to the eyepiece barrel. Tighten it lightly.

Cleaning and re-greasing the focusing mechanism of the eyelens

Avoid getting dust into the eyepiece during this work. Also avoid getting fingerprints or dirt on any exposed lens surfaces. Using nitrile rubber gloves may be a good idea at critical work moments.

1. Loosen and unscrew the field lens assembly from the bottom of the eyepiece (thread A in Figure 4.) Put away the field lens assembly in a dust free place. Having this part removed makes it more convenient to work with the focusing mechanism.

2. Loosen and unscrew the eyelens assembly from the top of the eyepiece (thread B in Figure 4, and Figure 8.) The thread is typically quite hard to release as it seems that it may have been secured with a threadlocker. Applying a threadlocker at manufacturing actually makes sense – a user would see it as a serious quality failure if the eyelens assembly released from the eyepiece when the user only attempted to change the eyepiece focus by turning the focus ring. But for servicing of the focus control the threadlocker is a nuisance. With some luck, you may be able to release the eyelens assembly from the barrel with your fingers only – if that indeed is the case, proceed to point 4. below. Most probably you will however find that the eyelens assembly is stuck in the threads - then you will have the following two options to choose from:

Figure 8: Removal of the eyelens assembly.

   A. **Procedure if the focus control is completely frozen and stuck in its fully contracted position** (i.e., screwed all the way down as in the right eyepiece in Figure 2.)

      The only way to access the frozen helicoid thread is to remove the eyelens assembly with force. Be aware that forced removal may lead to damage.

      Release the eyelens assembly by putting one strap wrench over the rim of the locking ring (Figure 5) and another strap wrench over the rim of the eyelens assembly. Tighten the straps and try to release the thread. Alternatively, after protecting the locking ring and the eyelens assembly as mentioned in section Releasing Stuck Threads use pliers and/or a vise to release the thread. Three outcomes are possible:

      a. The eyepiece assembly releases. Proceed to point 4. below to clean and regrease the helicoid thread.

      b. The eyepiece assembly will not release, but the use of the tools will force the stuck helicoid to open up into the focus control's extended position. This leaves you with three choices for how to continue:

         I. Proceed to point 5. below to remove the focusing tube from the helicoid thread while the eyelens assembly still is attached, or,

         II. proceed to point 3. below to release the eyelens assembly after soaking its thread with solvent, or,

III. continue using the tool(s) to escalate and increase the applied force until the eyelens assembly releases from the focusing tube. If you manage to remove the eyelens assembly without damaging it, proceed to point 4. below.

c. The eyepiece breaks. End of story.

B. **Procedure if the focus control <u>EITHER</u> can be tuned to its most extended position** (i.e., as in the left eyepiece in Figure 2), **<u>OR</u> if it is completely frozen and stuck in this position**.

You need to choose between two options:

a. Proceed to point 3. below to release the eyelens assembly after soaking its thread with solvent, or,

b. Proceed to point 5. below to unscrew the focusing tube from the helicoid thread while the eyelens assembly still is attached.

3. **Release and remove the eyelens assembly after soaking its thread with solvent.**

The threadlocker of the eyelens assembly will here be softened by treatment with solvent before we try to unscrew it from the focusing tube. Acetone will be used as the solvent (other common solvents as isopropanol or toluene don't work) and a wick manufactured from a short piece of wool yarn will help to keep the thread wetted with the solvent. Note that this approach only works if the eyelens focus can be unscrewed into (or near to) its most extended position. Acetone is very flammable – take any necessary safety precautions.

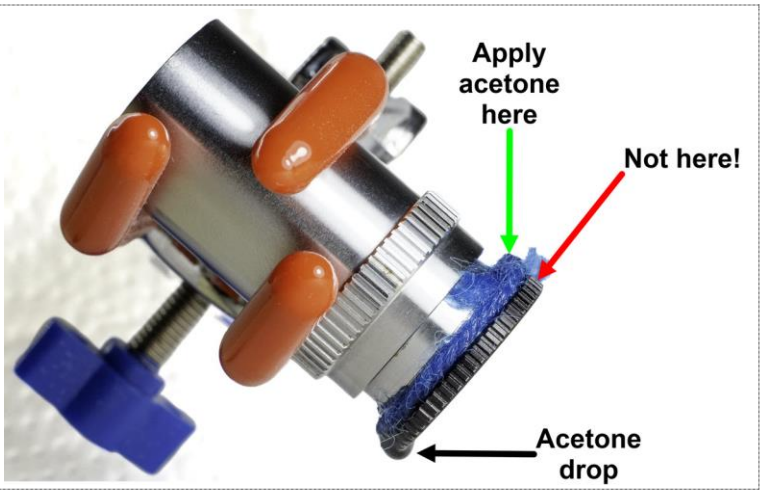

Figure 9: Acetone soaking of the eyelens assembly's thread.

Fasten the eyepiece in a clamp (or any other similar arrangement) with the eyelens assembly pointing downwards at approx. 45° (Figure 9.) Put a towel or some tissue a few cm (or in) under the eyepiece to catch and absorb any falling acetone drops. Tie a short string of a wool yarn (blue in Figure 9) around the thread of the eyelens assembly. Make sure that the yarn is attached as closely as possible to the thread. Use a pipette or an eye dropper to wet the yarn with acetone. Add the acetone dropwise to the yarn (at the green arrow in Figure 9) until the solvent starts to drop from the underside of the eyelens assembly. Avoid using too much solvent (flooding) and avoid getting solvent on any of the lens surfaces – the solvent should only wet the yarn and occasionally drop off from the underside of the eyelens assembly. Because acetone is so volatile, fresh acetone must be added every 3 minutes (until a drop again forms on the underside of the eyelens assembly.) It is important to make sure that the yarn remains wet and in good physical contact with the thread all the time. Continue the treatment for an hour, and then, without delay, remove the yarn and try to release the eyelens with the help of suitable tools (as per section Releasing Stuck Threads.) The eyelens assembly thread may still need some force to release, but the solvent treatment will significantly facilitate the effort.

Once released (Figure 8), consider not to clean the eyelens assembly thread from residual thread-locker. This may to some extent help to prevent the thread from accidentally releasing when the eyepiece is ready and back again in regular use.

Proceed to point 4. below to clean and regrease the helicoid thread.

4. **Clean and regrease the focusing control on an eyepiece where the eyelens assembly has been successfully removed** (Figure 8.)

Loosen and unscrew the focus mechanism's locking ring from the eyepiece barrel (Figure 10, and thread D in Figure 4.) The thread may be hard to release, and it is difficult to get a good grip around the eyepiece barrel. On one occasion I have found that putting the barrel in a freezer for a few hours greatly facilitated the removal of a stuck locking ring from the barrel. In any case, use rubber sheets to get a good grip.

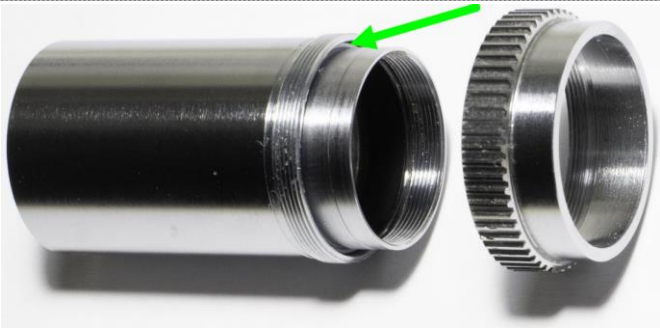

Figure 10: Removal of the locking ring for the focusing mechanism.

Unscrew and remove the eyelens focusing tube from the eyepiece barrel (Figure 11, and helicoid thread E in Figure 4.) If the old, hardened grease makes the removal difficult, press your finger against the inside of the focusing tube and rotate the tube counterclockwise to have it removed. Heating the barrel with hot air from an electric heat gun helps to soften old grease. If the focusing tube is completely stuck it can usually be unstuck by wetting the helicoid thread with a penetrating oil (e.g., WD-40.) Turn the eyepiece with its focusing tube facing up and put just a few drops of the penetrating oil into the crevice between the focusing tube and the eyepiece barrel (green arrow in Figure 10.) Let the penetrating oil work for a few hours before trying to release and unscrew the focusing tube. Avoid getting penetrating oil or solvent on the inside of the focusing tube – the ribbed surface on the inside is painted black (Figure 12) to eliminate internal reflexes, and the paint may dissolve by the oil or solvent.

Figure 11: Removal of the eyelens focusing tube.

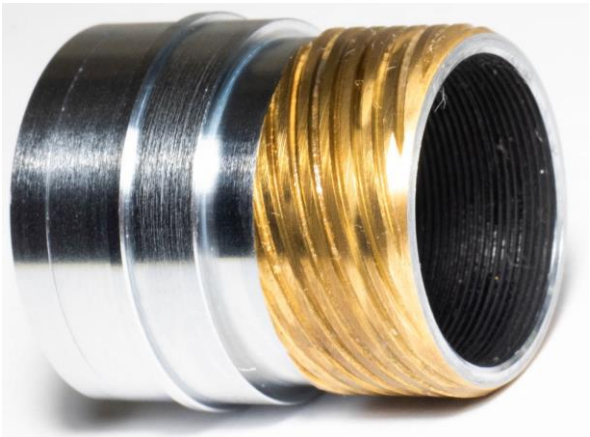

Figure 12: The eyelens focusing tube showing the helicoid thread and the inside with its black paint.

Use solvent (e.g., white spirit) to thoroughly clean off all of the old grease from both helicoid threads.

Apply a very thin layer of grease on the focusing tube's helicoid thread. Refer to section About Grease.

Reassemble the focusing tube to the helicoid thread on the inside of the eyepiece barrel. It may take some fidgeting to align the threads, also be careful to let the threads catch properly. Turn the tube back and forth a few times to distribute the grease evenly.

Put back the focusing mechanism locking ring (Figure 3) on the barrel and tighten it (not too hard) with your fingers.

Put your finger into the inside of the eyelens focusing tube and turn it counterclockwise as far as it goes. Hold your finger pressed onto the outside rim of the focusing tube to prevent it from rotating clockwise and replace the eyelens assembly by screwing it into the focusing tube thread (thread B in Figure 4.) Tighten the eyelens assembly with your fingers as much as possible. This thread should be left well tightened to avoid that the eyelens assembly inadvertently comes loose from the eyepiece when the eyelens focus is adjusted. If you wish to use a threadlocker to secure the eyelens assembly, follow the manufacturer's instructions. Typically, the thread must be thoroughly cleaned with acetone before any new threadlocker is applied. Avoid a stuck thread by staying away from the strongest threadlocker qualities – use medium or low strength threadlocker (e.g., Loctite "Blue" or "Purple", respectively.)

Check that the eyelens focus mechanism moves freely and smoothly through its entire range. Check that the lens surfaces are clean.

The eyepiece is ready for use.

5. **Remove the focusing tube while the eyepiece assembly still is attached to it.**

   This option only works if the focusing tube is in (or can be turned into) its extended position (as in the left eyepiece in Figure 2) to allow space for releasing the locking ring (Figure 3.)

   Loosen and unscrew the locking ring for the focusing mechanism from the eyepiece barrel (Figure 13, and thread D in Figure 4.) The thread may be hard to release, and it is difficult to get a good grip around the eyepiece barrel. Use rubber sheets to improve the grip (refer to section Releasing Stuck Threads.)

Figure 13: The eyepiece after the locking ring has been released.

   Unscrew and remove the eyelens focusing tube from the eyepiece barrel (Figure 14, and helicoid thread E in Figure 4.) Old, hardened grease may make the removal difficult. Carefully heating the outside of the barrel (but avoid heating the eyelens assembly) with hot air from an electric heat gun helps to soften old grease. If the focusing tube is completely stuck it can usually be unstuck by wetting the helicoid thread with a penetrating oil (e.g., WD-40.) Turn the eyepiece with its focusing tube facing up and put just a few drops of the penetrating oil into the crevice between the focusing tube and the eyepiece barrel (green arrow in Figure 15.) Let the penetrating oil work for a few hours before trying to release and unscrew the

focusing tube. Avoid getting penetrating oil or solvent on the inside of the focusing tube and, above all, keep the oil away from the eyelens assembly.

Figure 14: The eyelens focusing tube removed with the eyelens assembly still attached.

Figure 15: The green arrow points to the crevice where to put the penetrating oil.

Use solvent (e.g., white spirit) to thoroughly clean off all of the old grease from both helicoid threads.

Apply a very thin layer of grease on the focusing tube's helicoid thread. Refer to section About Grease.

Reassemble the focusing tube to the helicoid thread on the inside of the eyepiece barrel. It may take some fidgeting to align the threads, also be careful to let the threads catch properly. Turn the tube back and forth a few times to distribute the grease evenly.

Screw down the focusing mechanism locking ring (Figure 3) over the barrel thread and tighten it (not too hard) with your fingers.

Check that the eyelens focus mechanism moves freely and smoothly through its entire range. Check that the lens surfaces are clean.

The eyepiece is ready for use.