Leitz Lamphouse LH 20

Figure 1: Lamphouse LH 20. View of the light port with the two connection plugs and the black lamp socket on its right side.

Leitz lamphouse LH 20 is a compact and rather simple lamphouse for later Leitz Laborlux microscopes (and other contemporary microscopes as well, e.g., Dialux 22 EB, Labovert, etc.) with 160 mm mechanical tube length. It uses a 6V 20W halogen lamp bulb with a G4 bipin base powered by a basic 6V AC power supply unit in the foot of the microscope. Power is supplied through electrical connectors that are integrated in the two connection plugs that mechanically attach the lamphouse to the microscope's light port on the backside of the microscope. There is no external power connector. The halogen bulb sits in a black plastic lamp socket in the lamphouse's right side (Figure 1), but there are no controls for alignment/centering of the bulb. The lamphouse has a small, non-adjustable, concave mirror reflector behind the bulb, a non-focusable aspherical collector lens, and a clear glass filter (probably a heat absorbing filter.) It was manufactured in at least two versions with minor variances (Figure 2); for example, in the version with Leitz catalog no. 514 672 the rear mirror reflector can be removed, and also there is a small port (purpose unknown to me) on its left side (Figure 2.) Leitz also offered a lamphouse version, LH 20Z, that had controls for centering of the lamp bulb. A lamp holder with bulb alignment controls (catalog no. 514 673) could be separately purchased to upgrade lamphouse LH 20 to LH 20Z (refer to Appendix: An Upgrade - The Centerable Lamp socket.)

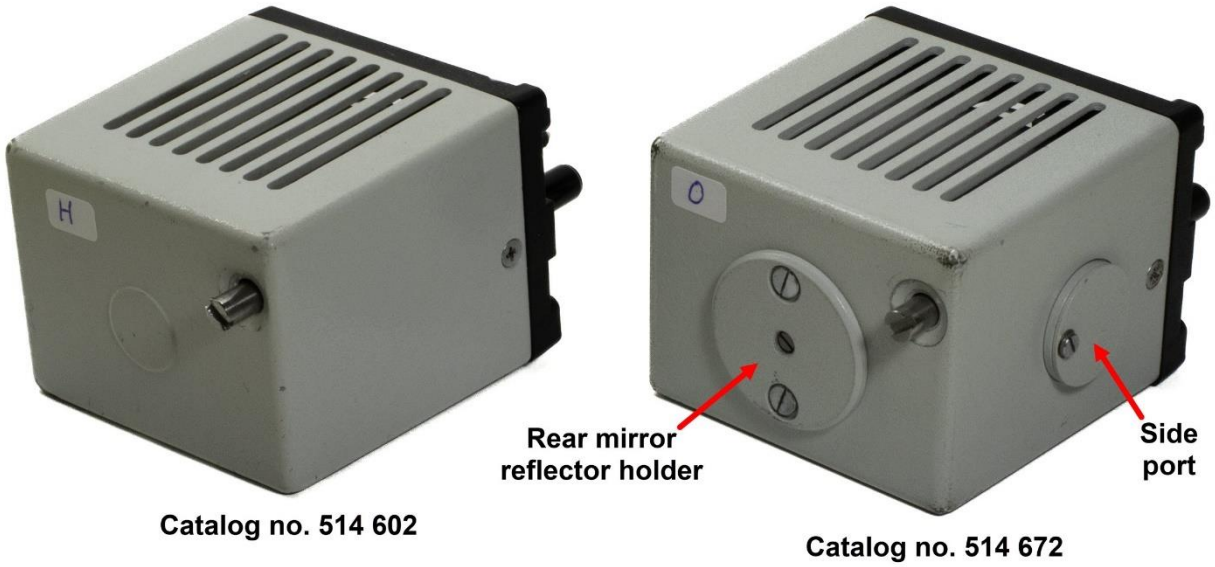

Figure 2: Two versions of Leitz Lamphouse LH 20. The backside of no. 514 672 shows the removable mirror reflector holder.

Scope

These maintenance notes describe the disassembly and reassembly of the Leitz lamphouse LH 20 including a few maintenance tasks.

Disassembling the Lamphouse

Disconnect the microscope from the mains (remove the mains power cord.)

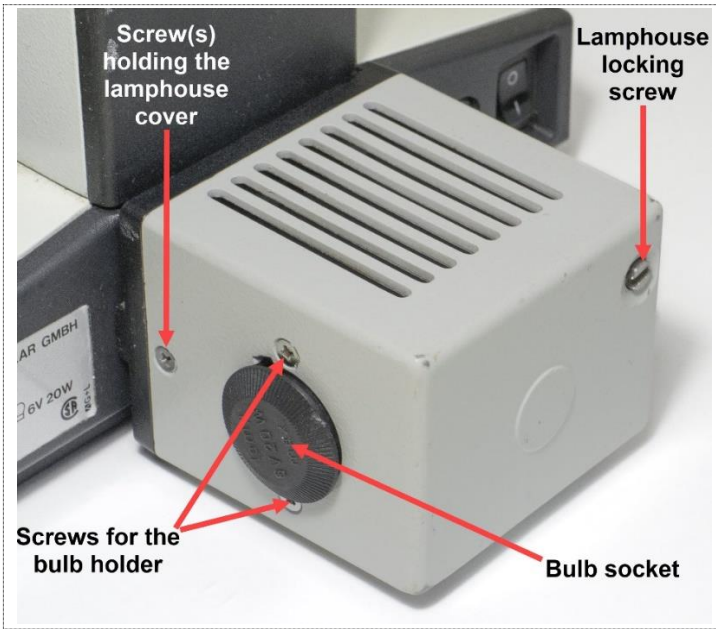

Figure 3: Leitz lamphouse LH 20 (cat. no. 514 602) attached to the backside of a Laborlux microscope.

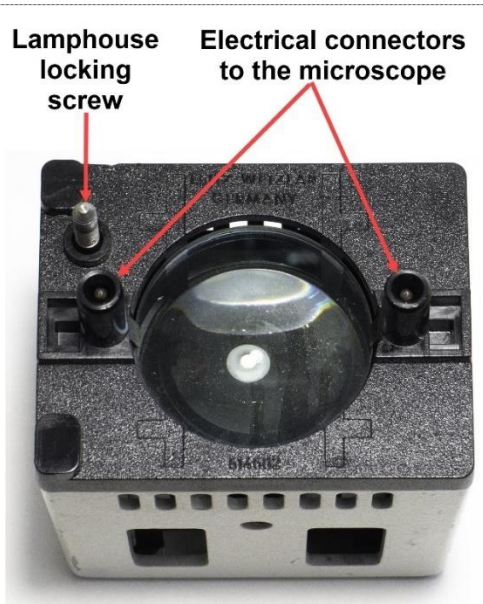

Figure 4: The light port on the front of the lamphouse. Note the connection plugs with the integrated electrical connectors.

Loosen the long lamphouse locking screw (Figure 3, Figure 4 and Figure 5) that holds the lamphouse attached to the backside of the microscope. The lamphouse is now only loosely attached to the microscope by the two electrical connection plugs that stick out from the lamphouse's base plate (Figure 4 and Figure 5.) Remove the lamphouse by pulling it out from the microscope.

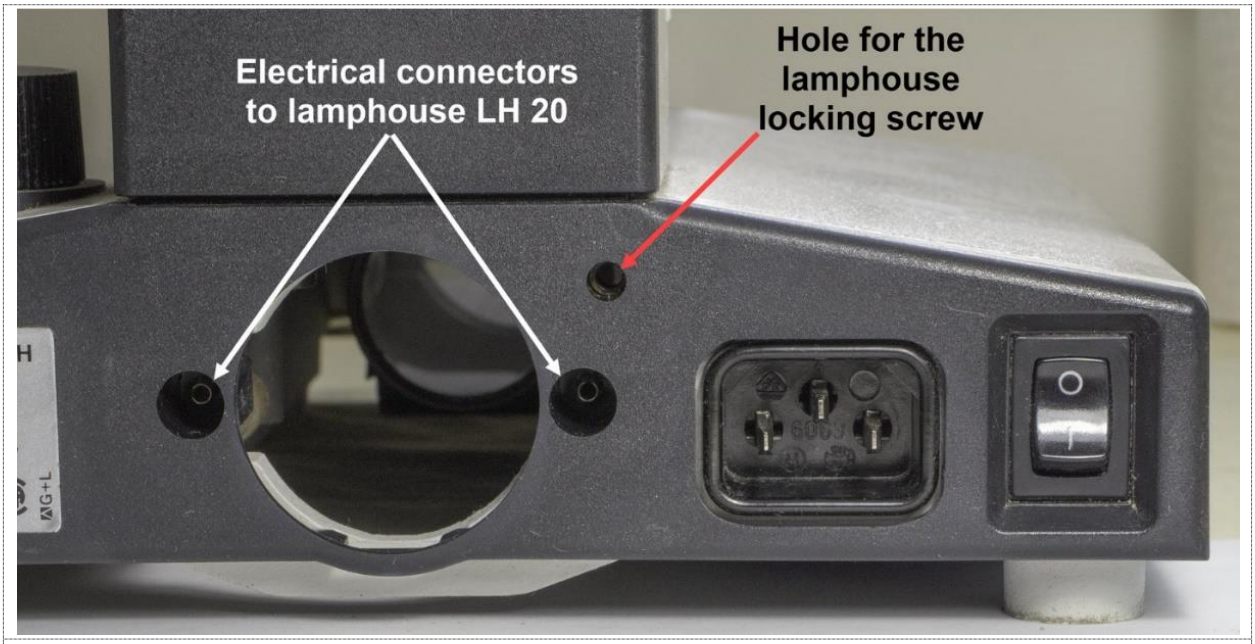

Figure 5: The backside of a Laborlux microscope where Lamphouse LH 20 is attached.

The lamphouse may include an additional push-on diffuser disc (catalog no. 514 623, Figure 6) that faces the microscope and is attached over the lamphouse's two connection plugs. It is not clear to me whether the diffuser disc was supposed to always be used with the lamphouse, or if it was an optional accessory. It is basically a frosted glass filter mounted in a black plastic frame. The plastic frame is unfortunately fragile (probably due to aging) and the snap-lock pins are prone to break off. From a usability standpoint the broken snap-lock pins don't matter much because the filter unit is anyway firmly held in place by the lamphouse's two connection plugs.

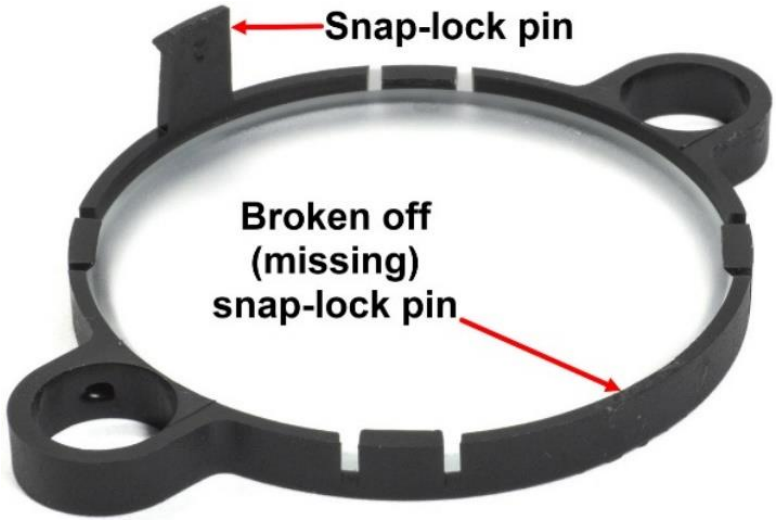

Figure 6: The push-on diffuser disc (frosted glass filter) with its black plastic frame. It is attached to the light port of Lamphouse LH 20.

Remove the bulb socket (Figure 3 and Figure 7) from the lamphouse. Push down the socket with your fingers, turn it counterclockwise, and pull it out. Never touch the halogen bulb with your bare fingers.

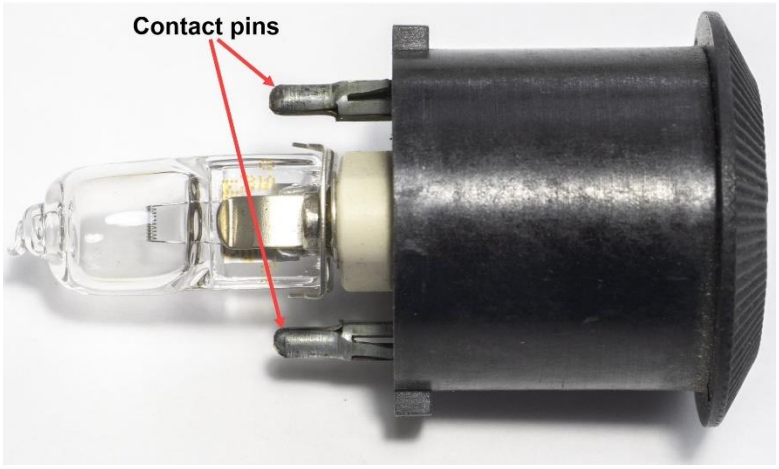

Figure 7: Lamp socket after removal from the lamphouse.

Remove the lamphouse cover (Figure 8 and Figure 9) from the lamphouse's base plate (including the bulb holder, Figure 12) by unscrewing first the two screws with Philips heads that sit on opposite sides of the lamphouse (Figure 3) and then the two similar screws for the bulb holder that sit next to the bulb socket (Figure 3.) It also helps to remove the concave mirror reflector from the lamphouse's backside (in case it is removable, like in the lamphouse variant with catalog no. 514 672.) The base plate and the bulb holder are connected by short electrical wires. After the cover has been separated from the base plate and bulb holder, the long lamphouse locking screw (Figure 11) and the removable light shield (Figure 9 and Figure 10) can be removed.

Figure 8: The inside of the lamphouse (514 602) cover. The concave lamp mirror reflector is in the middle, and the bottom side's heat vent openings with the black light shield (not removable) are visible at the top of the image.

Figure 9: The inside of the lamphouse (514 602) cover. The upper side's heat vent openings with the black removable light shield are visible at the top of the image.

Figure 10: The same black removable light shield as in Figure 9 after it has been removed from the lamphouse.

The lamphouse locking screw has either an E-clip (on catalog no. 514 672) or a small tip jutting out from its side (on catalog no. 514 602, indicated by a red arrow in Figure 11.) The clip/tip prevents the screw from being removed and lost from the lamp-house by just pulling it out – the screw can only be removed from the inside of the lamphouse after it has been disassembled.

Figure 11: The lamphouse locking screw.

To dissipate the heat generated by the halogen bulb the lamphouse has vent openings on its top and bottom (Figure 8 and Figure 9.) On the insides of the vents are light shields that block distracting stray light from radiating through the vent openings. The shield at the bottom of the lamphouse (Figure 8) is attached to the lamphouse cover, while the shield at the top (Figure 9) comes loose (Figure 10) when the lamphouse is disassembled.

The lamphouse's base plate (Figure 12 and Figure 13) is made of black plastic and provides the electrical connectors and wiring for the lamp bulb. It also holds the non-adjustable aspherical collector lens (a.k.a. condenser lens) situated next to the bulb and then further out the heat absorbing filter.

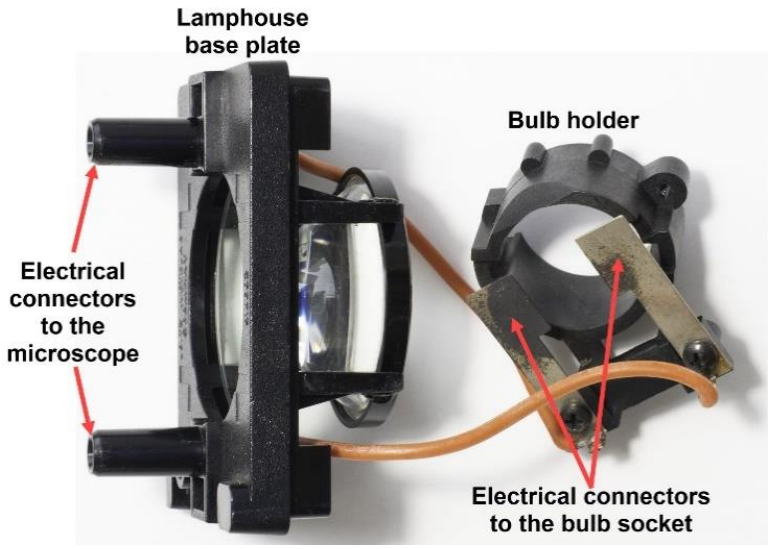

Figure 12: The lamphouse base plate with the bulb holder.

After several years of use and exposure to heat from the bulb the collector lens and the filter surfaces may have become hazy and may therefore need careful cleaning. Ideally one would prefer to remove the collector lens and the heat filter from the base plate to access and clean their surfaces, but in this case I would advise against doing so because removing them could break the aged and apparently brittle plastic parts that hold them aligned in the optical path. Probably the heat from the halogen bulb has accelerated the aging of the plastics. The glass surfaces can with some effort be cleaned without being removed by using a suitable lens cleaning solution and clean cotton swabs.

Figure 13: Another view of the internal parts (except the lamp socket) of lamphouse LH 20, this time of no. 514 672. The removable rear mirror reflector is on the top right.

If you still prefer to remove the heat absorbing filter and/or the collector lens before cleaning them proceed as follows:

Heat absorbing filter: The filter is loosely resting on shoulders on the four collector lens spacers (Figure 14 and Figure 15) and then held in place by two thin (and fragile) plastic locking pins. Release the filter by using a small screwdriver to gently push the locking pin ends outward from the filter and then lift the filter off from the shoulders. Clean the filter, dry it, and push it back on the spacer shoulders. Make sure that the locking pins snap back to hold the filter in place.

Collector lens: The lens sits loose (i.e., not cemented) in a black circular plastic lens mount. The mount is glued (or perhaps welded) to slits in the top ends of the four collector lens spacers. Carefully pry off the mount from the spacers without breaking anything (which may be challenging.) Now the lens can be removed from the mount. After cleaning and drying, put back the lens into the mount (with the bulging side facing the heat absorbing filter) and reattach the mount with the lens into the slits in the spacer tips. Check that the mount is properly seated on the spacer tips and apply small drops polystyrene cement to reliably attach the mount to the spacers. Avoid getting any cement on the collector lens.

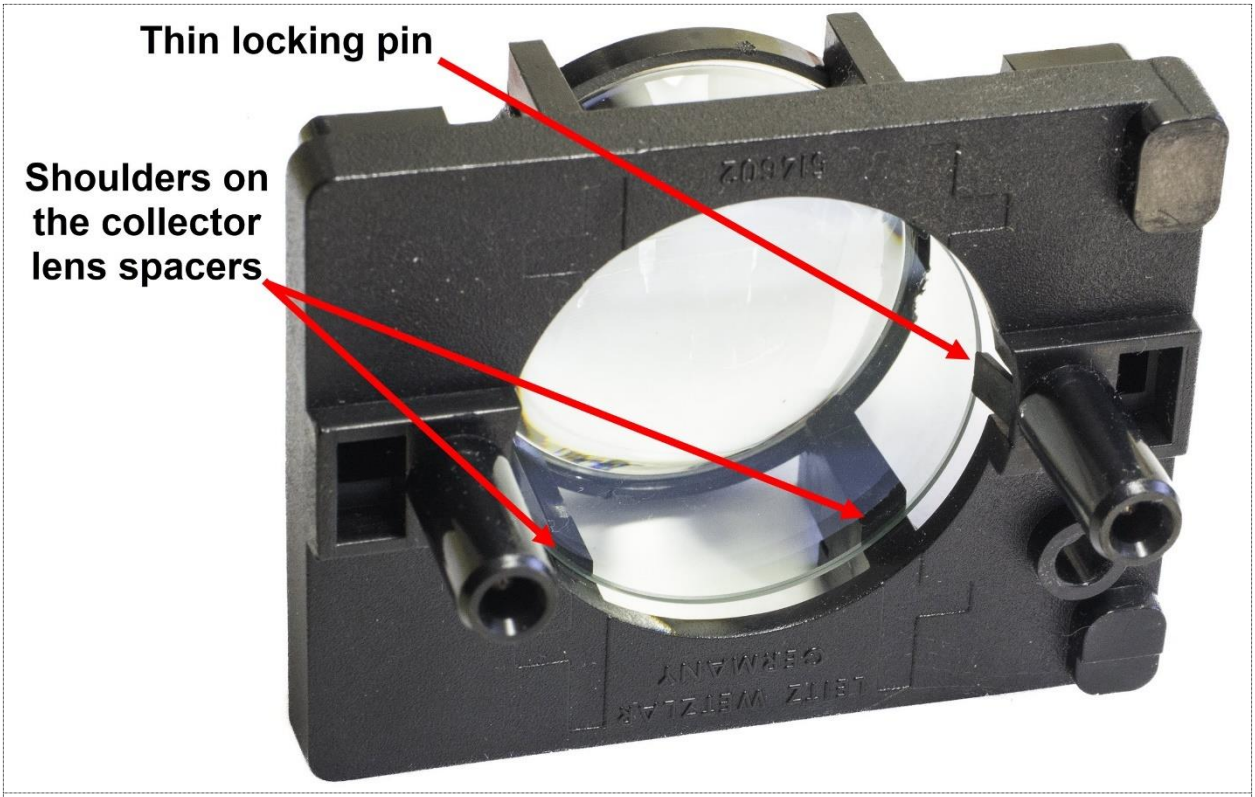

Figure 14: The heat absorbing filter in the light exit port of lamphouse LH 20.

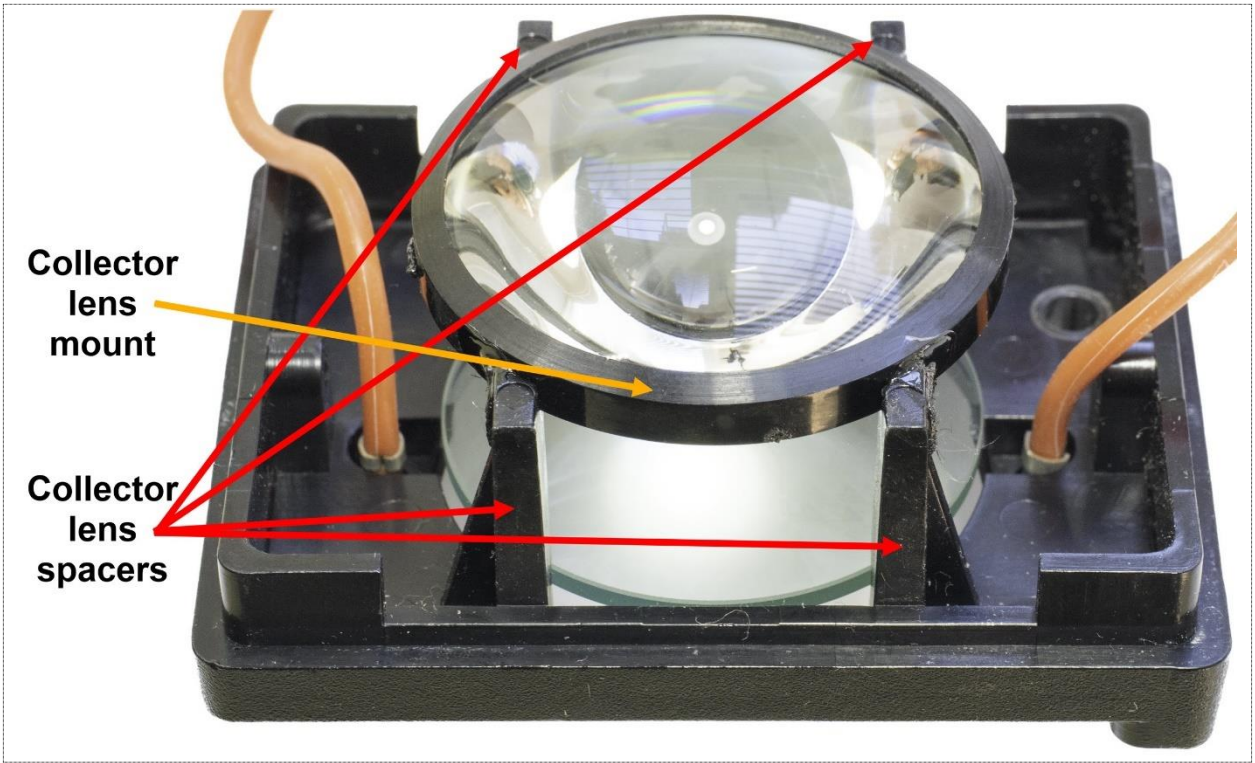

Figure 15: The aspherical collector lens attached to the lamphouse base plate.

Reassembling the Lamphouse

Reassembly of the lamphouse needs to be done in a certain order.

Start by attaching the bulb holder (Figure 12) to the inside of the lamphouse cover using the two Philips screws. The base plate is attached to the bulb holder by wires that are short and unfortunately tend to get in the way for the reassembly. Good workplace illumination and forceps are helpful to cope with this. Make sure that the rim of the plastic bulb holder fits snugly into the opening in the side of the lamphouse before tightening the Philips screws.

Place the lamphouse cover on the table with its opening facing upwards (Figure 9.) Insert the removable light shield (Figure 10) into the lamphouse. The black (or at least the darker) side of the shield should preferably face the vent openings. Fit the shield's two "legs" into the slots on the inside of the lamp-house cover (Figure 9.) From now on, keep an eye on the shield - the "legs" are prone to slipping out of the slots which jeopardizes the lamphouse reassembly.

Put the long lamphouse locking screw into its hole in the lamphouse cover so its head sticks out on the outside of the cover (Figure 3.) It must be attached from the inside of the cover and with the E-clip or the tip on the side of the screw (Figure 11) located on the inside of the cover.

Attach the black plastic base plate of the lamphouse (Figure 12) to the lamphouse cover. While doing this make sure that 1) the locking screw's threaded end sticks through its hole in the base plate, and 2) that the upper side of the removable light shield slides into the slots that are provided for this on the inside of the base plate. It requires dexterity and patience to simultaneously get the locking screw and the light shield in their proper positions while attaching the base plate. The light shield may need a poke with a toothpick from the outside of the heat vent to properly slip into its slots. The movements of the involved parts are constrained by the short wires to the bulb holder and furthermore the wires tend to get in the way. Also check that the wires don't end up in the way in the lamphouse's optical path.

Once everything is properly positioned, secure the base plate to the cover by the two Philips screws (Figure 3.)

Attach the bulb socket (with the halogen lamp bulb) to the lamphouse. Push the socket down, turn it clockwise, and release it.

Reattach the lamphouse to the microscope and secure it by tightening the tall locking screw.

Check that the lamp lights up on power on.

Choice and Alignment of the Lamp Bulb

Lamphouse LH 20 is clearly specified to be used with a 6V 20W halogen bulb with a G4 bipin base, but the size, shape and position of the halogen bulb's filament also affect the illumination. Unfortunately, I haven't been able to find any official filament or bulb specifications provided by Leitz for lamphouse LH 20. Searching the Internet one can however find some more or less anecdotical information about supposedly suitable bulb makes and models. The "Osram ESB 64250 HLX 20W 6V" halogen bulb is one example, but similar bulbs from other manufacturers are also identified. The larger halogen bulb manufacturers typically issue data sheets that include the filament size, shape, and position parameters.

It's important to understand that while regular halogen lamps have average lives of 1000-2000 hours, the specialized scientific halogen bulbs (like the above mentioned Osram bulb) that often are used in high-end projectors and laboratory or medical equipment only have average lives of 50-100 hours. These specialized bulbs are brighter than the regular bulbs and also provide a somewhat colder light (approx. 3400K vs. 3200K.) The life of the specialized halogen bulbs can be extended by running them at slightly lower voltage than the nominal (one rule-of-thumbs says that a 5% voltage reduction will double the life), but this of course also decreases the light intensity and color temperature. Avoid reducing the voltage by more than 30% as this has been reported to jeopardize the bulb's halogen regenerative cycle resulting in an increasing darkening rate of the bulb envelope.

Always keep halogen bulbs completely clean and protect them from any fingerprints, contamination, and dirt. Always handle halogen bulbs wrapped in tissue, never touch the bulb with your fingers.

A general international trend is that halogen bulbs are being phased out due to energy saving and global warming concerns. Probably halogen bulbs for scientific use will remain available for several more years, but one should still expect steadily increasing scarceness and costs.

To fine-tune the illumination conditions advanced microscope lamps typically have mechanisms for focus adjustment of the lamp collector, for centering of the lamp bulb, and for focusing and centering of the rear mirror reflector. For a strict Köhler illumination setup one would need to 1) adjust the collector's focus to project a sharp image of the bulb filament on the plane of the aperture diaphragm, 2) make adjustments to center the image of the filament on the aperture diaphragm, and 3) to adjust the lamphouse position or focal length of the collimator to ensure that the filament image just fills the entire opening of the aperture diaphragm. Lamphouse LH 20 doesn't have any of these adjustment provisions. Limited lamp alignment can however be done by changing how the halogen bulb is attached in the lamp socket. The bulb can be pushed down to different depths in the socket, and the bulb can be slightly rocked sideways, but be careful with bending the pins of the halogen bulb – this may break the fused silica envelope. In the 514 672 lamphouse version the screws that hold the mirror reflector attached to the lamphouse (Figure 2) have some play that allows for very limited up-down and left-right adjustments. The bulb centering can be checked (and to some extent adjusted, as hinted above) by projecting the filament image on a frosted glass disc placed as close as possible to the aperture diaphragm.

Attaching the push-on diffusing disc (Figure 6) over the lamphouse's electrical connectors may smooth out some of the shortcomings of the LH 20 lamphouse, but at the cost that this introduces a deviation from the strict Köhler illumination protocol.

Failure to Power up the Lamp

Four issues may prevent the lamp from lighting up:

1. The halogen bulb is faulty (burnt filament, broken quartz glass, broken pins.)
2. The power supply unit in the microscope foot is faulty.
3. The electrical connections between the microscope and the lamphouse are faulty.
4. The electrical connections between the lamphouse's bulb holder and bulb socket are faulty.
5. The electrical connections between the bulb socket and the bulb are faulty.

A multimeter capable of measuring resistance is useful for fault finding of electrical connections.

Here are some remedies to try out:

1. Broken or burned-out halogen bulb.

Replace the bulb with a new 6V 20W halogen bulb with a G4 bipin base. Try to find a replacement bulb where the filament is of the same shape and in the same position as in the original bulb (also refer to section Choice and Alignment of the Lamp Bulb above.) Lamphouse LH 20 doesn't have any lamp alignment provisions, therefore it is important that the replacement bulb's geometry is as similar as possible to the original bulb. To replace the bulb, push in the bulb socket (Figure 3 and Figure 16) with your fingers, turn it counterclockwise, and pull it out. Carefully replace the bulb. Always keep halogen bulbs completely clean and protect them from any fingerprints, contamination, and dirt. Always hold the new halogen bulb wrapped in tissue, never touch the bulb with your fingers. Put back the bulb socket with the new bulb into the lamphouse, push it down as far as it goes, and turn it clockwise to lock it in its proper position.

2. Faulty power supply.

Check that the microscope is connected to the mains and that the power switch is on. Turn the power supply rheostat knob on the microscope's foot back and forth. Check that the power supply unit's fuses (accessible from the bottom plate of the microscope, Figure 16) are working and are not blown. Use an AC voltage meter to trace if and where the power supply unit may be faulty. Replace or repair the power supply unit if faulty (the power supply unit is of a simple design.)

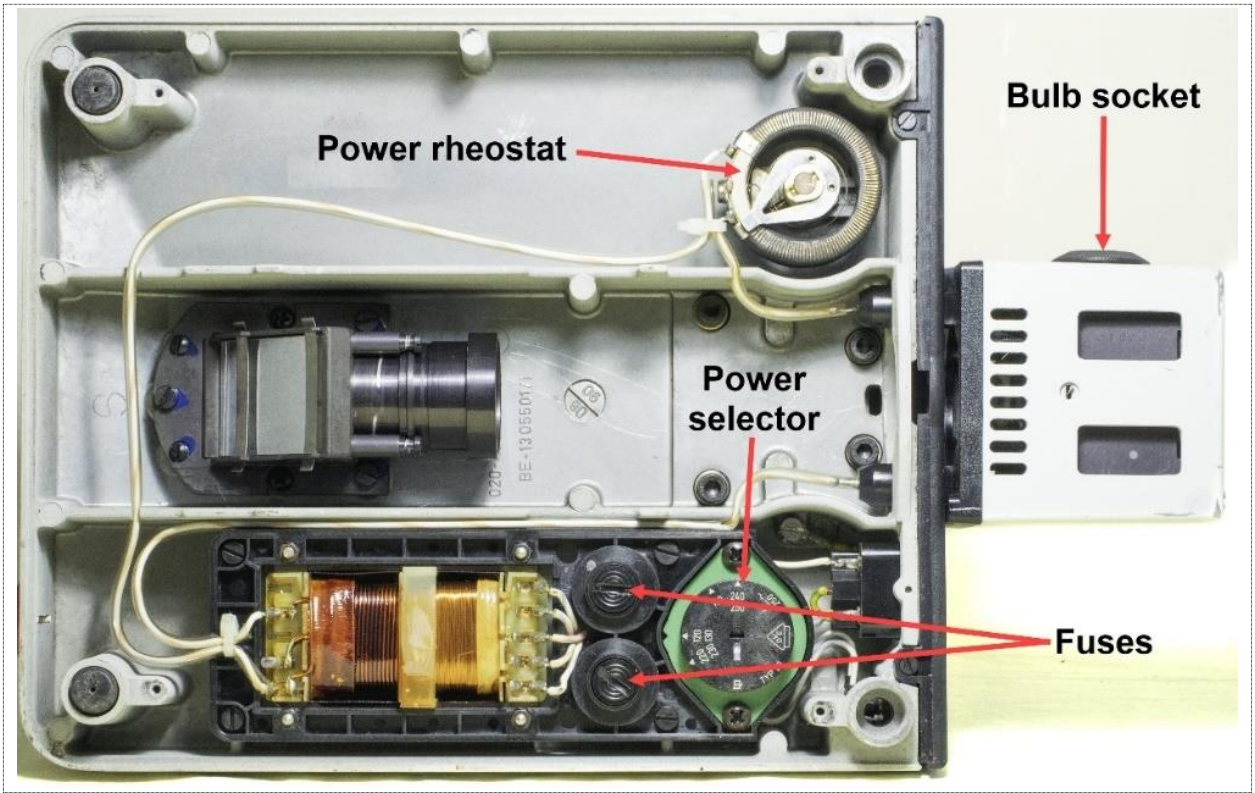

Figure 16: The underside of a Laborlux microscope with the bottom cover removed and lamphouse LH 20 attached.

3. Faulty electrical connections between the microscope and the lamphouse.

Use an AC voltage meter to find out whether the electrical connections between the microscope and the lamphouse could be faulty. Remove the lamphouse from the microscope and check the electrical connections. Adjust or repair as necessary.

4. Faulty electrical connections between the lamphouse's bulb holder and the bulb socket.

Remove the lamphouse from the microscope, and then remove the bulb holder from the lamphouse. Check the electrical connections between the bulb holder and the bulb socket. Adjust or repair as necessary – typically, the sheet metal connectors of the bulb holder (Figure 12 and Figure 13) may need to be bent to exert more pressure against the bulb socket's contact pins (Figure 7), or the connector surfaces may need to be cleaned from oxides by treatment with a suitable metal polish (e.g., Autosol) or light sandpapering with a very fine sandpaper.

5. Faulty electrical connections between the bulb socket and the bulb.

This can happen if the bulb socket's pin connectors are too loose and don't grip hard enough around the bulb pins. The fault is typically recognized by noticing that the bulb slips into the bulb socket with little or no resistance. Use a steel needle to slightly bend the U-shaped sheet metal connectors in the bulb socket to provide a narrower grip around the bulb pins (Figure 17.)

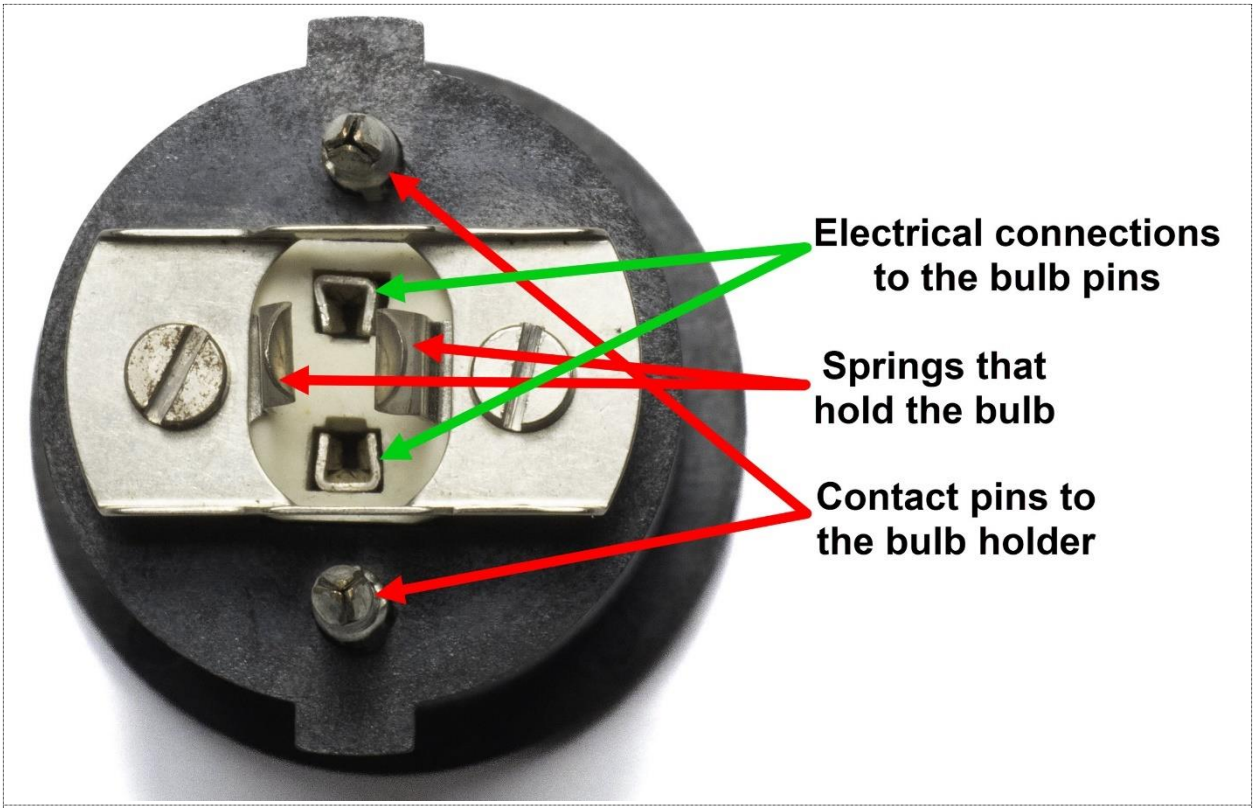

Figure 17: View from the top of the bulb socket with the bulb removed. Note how the previously ideally U-shaped sheet metal connections to the bulb pins have been slightly bent into a narrower shape to get a tighter grip around the bulb pins.

Appendix: An Upgrade - The Centerable Lamp socket

As mentioned previously, compared to advanced microscope lamps, lamphouse LH 20 has three design weaknesses – the collector lacks a focusing capability, and neither the rear mirror reflector nor the lamp bulb is alignable. Fortunately, the latter of these weaknesses can be remedied by swapping the default lamp socket for an improved version that includes an alignment mechanism - the centerable lamp socket, cat. no. 514 673 (Figure 18.) This upgrade converts lamphouse LH 20 into lamphouse LH 20Z (Figure 20.) (The "Z" suffix, for "Z" as in the "Z coordinate", was Leitz' way to indicate that a lamphouse model was equipped with an alignable lamp socket.)

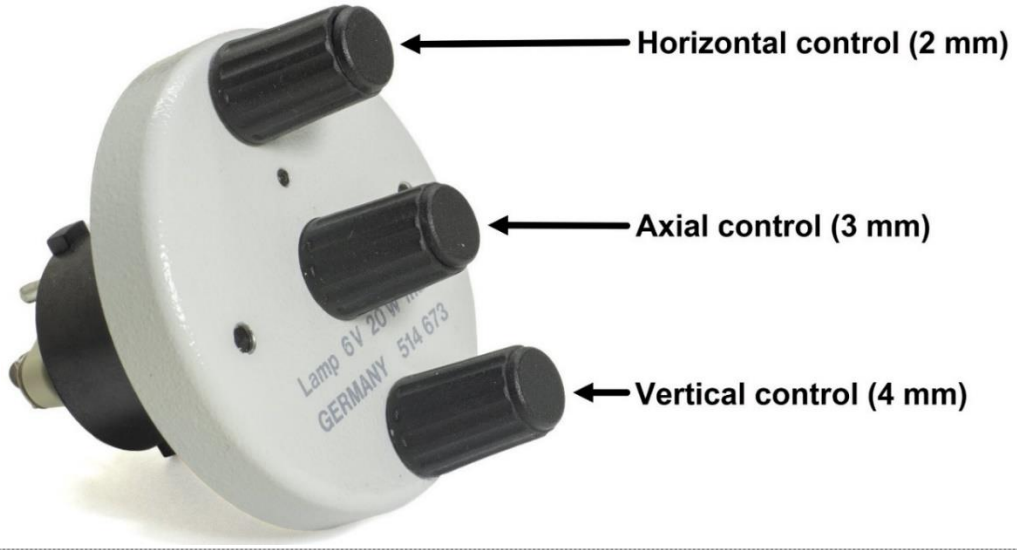

Figure 18: The alignable lamp socket, cat. no 514 673. Approximate moving ranges indicated within parentheses.

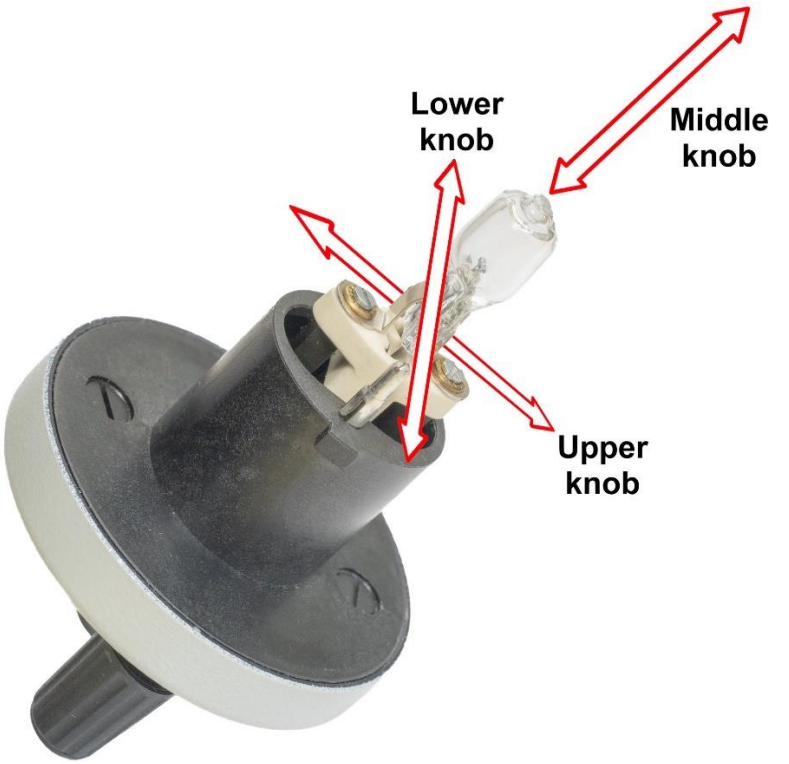

Figure 19: Illustration of how the three knobs affect the bulb alignment.

The three knobs on the lamp socket allows for lamp bulb alignment in three dimensions. Figure 19 and the following table show how the knobs move the bulb:

Knob	**Bulb moving direction** (with reference to a viewer that faces the knobs)	**Bulb moving direction** (with reference to the lighthouse's optical axis)	**Moving range** (mm)
Upper	Horizontal	Back-and forth (along the Z axis)	2
Middle	Axial	Sideways (horizontal, X axis)	3
Lower	Vertical	Up-and-down (vertical, Y axis)	4

Figure 20: Lamphouse LH 20 updated with the alignable lamp socket (cat. no 514 673.) This makes it equivalent to lamphouse LH 20Z.

The bulb moving ranges appear limited, but recall (section Choice and Alignment of the Lamp Bulb) that the lamp alignment also can be changed by how the bulb is attached in the socket.