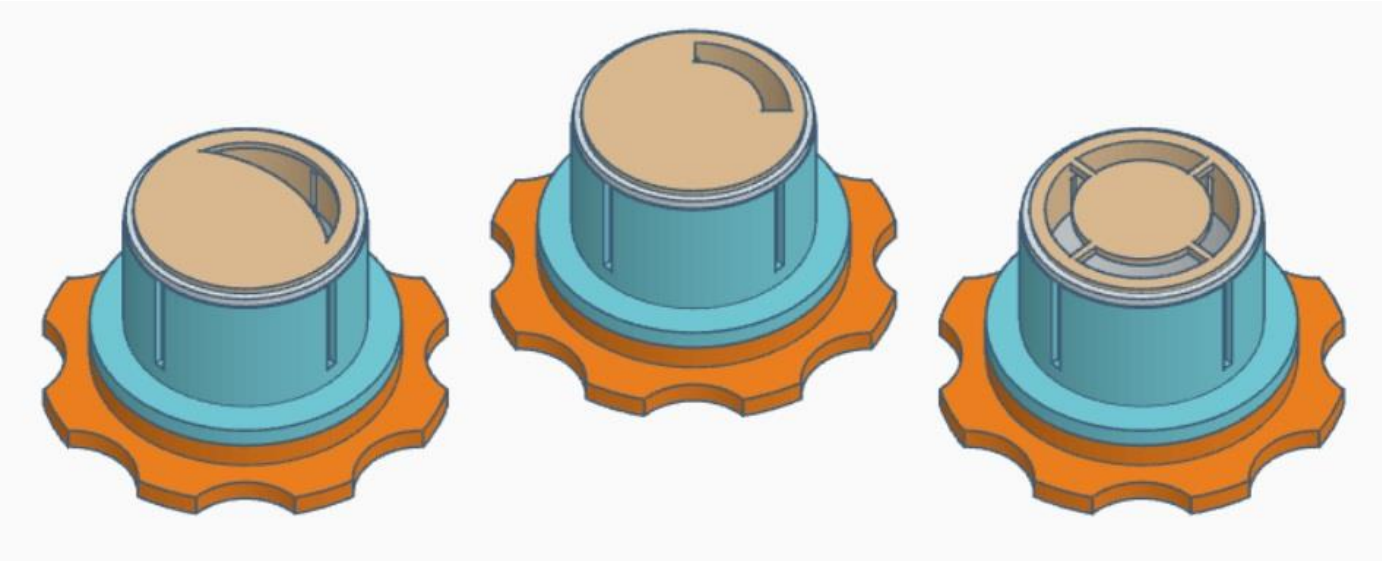
An Oblique Accessory Kit for Olympus BH-2 Microscopes

Revision 3



Revision History		
Revision	**Description of Changes**	**Date**
1	Initial release	July 29, 2022
2	Clarified -CD and -AAC versions	August 1, 2022
3	Common format and better images. Added more inserts and iris diaphragm warning.	August 26, 2022

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Introduction

Oblique illumination is a microscopy technique that reached its peak in popularity in the late 19th century before the existence of high N.A. objectives. Back then, oblique illumination was commonly used to highlight details in specimens that were otherwise difficult to see with the limited optics of the time. Oblique illumination works by projecting light onto the specimen under observation from an off-center (i.e., non-axial) position, creating shadowing which reveals specimen details which might otherwise be difficult to see under standard axial illumination. With the subsequent availability of high N.A. objectives towards the end of the 19th century, the technique lost much of its favor since it then became possible to see previously elusive details under standard axial illumination.

Thanks to the ease with which oblique illumination can be added to a modern biological light microscope, this technique is once again popular with amateur microscopists. Oblique illumination can be added to most microscopes by simply placing an off-center aperture stop beneath the aperture diaphragm within the microscope condenser, thereby obscuring on-axis light and allowing only oblique light to strike the specimen. For best results, this stop should be placed as close to the aperture diaphragm as physically possible.

The collar-mount condensers used on many microscopes are constructed such that a filter carrier, which is present on the bottom of the condenser, is sufficiently close to the aperture diaphragm that oblique stops placed within this carrier provide good results. In comparison, microscopes which use dovetail-mounted condensers (such as the Olympus BH-2 and similar Nikon scopes from the same era), are notoriously difficult for the amateur to equip for oblique illumination. The reason for this difficulty is that the condensers on these scopes are constructed in such a way that it is not possible for a filter carrier on the bottom of the condenser to position a stop sufficiently close to the aperture diaphragm to provide effective oblique illumination. In order to use a simple stop to obtain oblique illumination on these scopes, a carrier of some sort is necessary which can be placed up into the bottom bore of the condenser to position the stop sufficiently close to the aperture diaphragm within.

Scope of this Document

This document details the construction and usage of the *BH2-OBL Accessory Kit*, which is a 3D-printed accessory kit that allows the Olympus BH-2 line of microscopes to be equipped for simple oblique illumination. While intended primarily for oblique illumination, the *BH2-OBL* also includes limited provisions for darkfield and for compatibility with user-made stops and filters.

Versions of the BH2-OBL

There are two distinct versions of the *BH2-OBL*. The *BH2-OBL-CD* version, which was designed to be used with the Olympus BH2-CD condenser (the non-corrected Abbe condenser commonly found on BHT and BHTU scopes, which has an N.A. of 1.25), and the *BH2-OBL-AAC* version, which was designed to be used with the Olympus BH2-AAC condenser (the aplanatic achromatic condenser commonly found on BHS scopes, which has an N.A. of 1.4). While the body of the *BH2-OBL* is common to both versions, the stop inserts differ between versions. The *BH2-OBL-CD* inserts are sized for the BH2-CD condenser, whereas the *BH2-OBL-AAC* inserts are sized for the slightly deeper BH2-AAC condenser (the *BH2-OBL-AAC* inserts protrude a bit deeper into the BH2-AAC condenser bore, when mounted in the *BH2-OBL* body.

Cross-Compatibility

The *BH2-OBL-CD* inserts can be freely used with either the Olympus BH2-CD or the BH2-AAC condensers. When the *BH2-OBL-CD* inserts are used in the BH2-AAC condenser, the inserts will be positioned a bit further away from the aperture diaphragm than if the recommended *BH2-OBL-AAC* inserts were used. This means that the results obtained using the *BH2-OBL-CD* stops in the BH2-AAC condenser will in theory be inferior to what the *BH2-OBL-AAC* stops would provide, although the difference is likely minor.

The BH2-OBL-AAC inserts should never be used in the Olympus BH2-CD condenser, as damage to the internal iris mechanism of the BH2-CD condenser could result.

The BH2-OBL Accessory Kit

The *BH2-OBL Accessory Kit* consists of a collection of simple plastic parts which can be made using virtually any low-cost 3D FDM printer. These parts allow the *BH2-OBL* to provide the three illumination modes shown in **Figure 1**.

Figure 1 – Three configurations of the BH2-OBL

The BH2-OBL Body

The assembled *BH2-OBL* (with an insert installed) is shown in **Figure 2**.

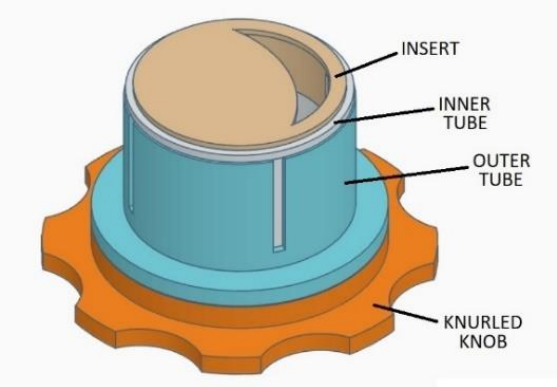

Figure 2 – The assembled BH2-OBL with insert

An exploded view of the *BH2-OBL* (with insert) is shown in **Figure 3**.

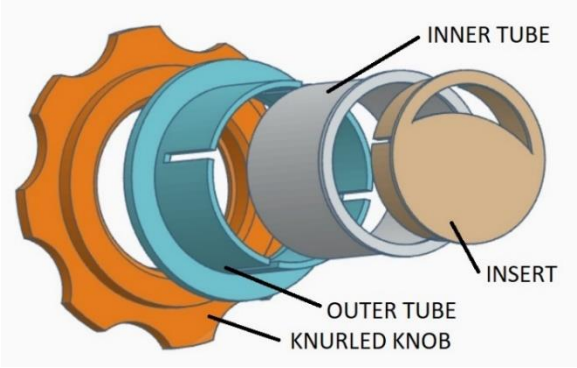

Figure 3 – Exploded view of the BH2-OBL with insert

The BH2-OBL Inserts

There are two stop insert sets included in the *BH2-OBL Accessory Kit* (the *BH2-OBL-CD* set and the *BH2-OBL-AAC* set). The *BH2-OBL-CD* inserts can be differentiated from the *BH2-OBL-AAC* inserts, by the presence of the thinner flange on the *BH2-OBL-CD* inserts (**Figure 4**).

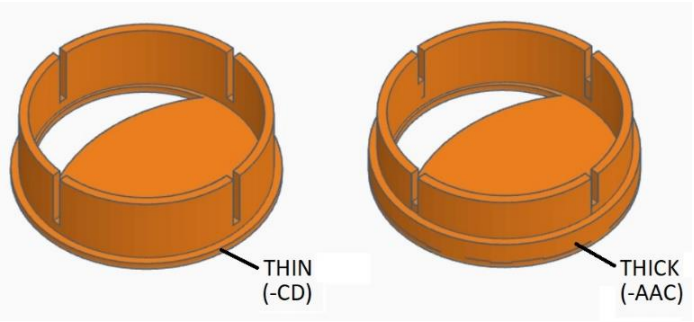

Figure 4 – Comparison of the BH2-OBL insert types

The thicker flange on the *BH2-OBL-AAC* inserts makes the *BH2-OBL-AAC* stops stand higher above the end surface of the inner tube of the *BH2-OBL* than the *BH2-OBL-CD* inserts (**Figure 5**). This difference in height means that the *BH2-OBL-AAC* inserts protrude a bit deeper into the condenser bore than the *BH2-OBL-CD* inserts, which is necessary since the aperture diaphragm of the BH2-AAC condenser is a bit deeper in the condenser body than that of the BH2-CD condenser.

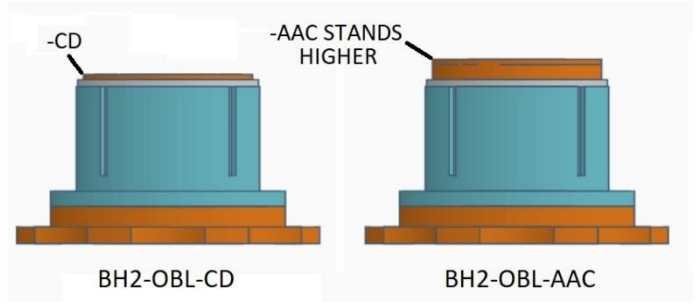

Figure 5 – Comparison of the BH2-OBL stop heights

The *BH2-OBL-CD* stop insert set, which is part of the *BH2-OBL Accessory Kit,* is shown in **Figure 6**.

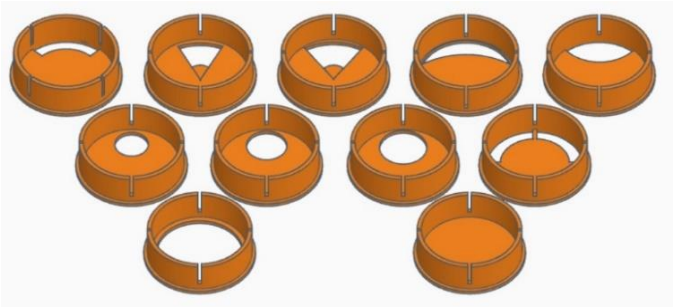

Figure 6 – The BH2-OBL-CD Stop Insert Set

The *BH2-OBL-AAC* stop insert set, which is part of the *BH2-OBL Accessory Kit*, is shown in **Figure 7**.

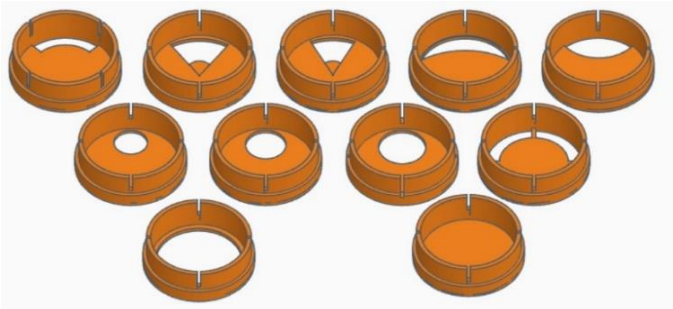

Figure 7 – The BH2-OBL-AAC Stop Insert Set

OBLIQUE INSERTS

Both the *BH2-OBL-CD* and *BH2-OBL-AAC* stop insert sets include the oblique insert types listed below.

- Oblique Sector, Narrow
- Oblique Sector, Wide
- Oblique Crescent
- Oblique Football
- Oblique Circle, Small
- Oblique Circle, Medium
- Oblique Circle, Large

OBLIQUE DARKFIELD INSERTS

Both the *BH2-OBL-CD* and *BH2-OBL-AAC* stop insert sets include the oblique darkfield insert type listed below. This insert is a standard 20mm darkfield patch stop with three of the four illuminating quadrants obscured, which provides oblique darkfield capability to the *BH2-OBL* for objectives up to 40X.

- Oblique Darkfield, 20mm

DARKFIELD INSERTS

Both the *BH2-OBL-CD* and *BH2-OBL-AAC* stop insert sets include the darkfield insert type listed below. This insert is a standard 20mm darkfield patch stop, which provides darkfield capability to the *BH2-OBL* for objectives up to 40X.

- Darkfield, 20mm

CUSTOM INSERTS

Both the *BH2-OBL-CD* and *BH2-OBL-AAC* stop insert sets include the two custom insert types listed below.

- Closed Insert
- Open Insert

The closed insert can be used to make custom aperture stops for specific oblique applications, by printing the stop from the appropriate STL file and then physically modifying it as necessary to produce the desired illuminating aperture(s). Alternatively, the STL file for the closed insert can be imported into appropriate 3D modeling software and edited within, to print the desired stops.

The open insert will accommodate custom-made stops or filters of 28.4mm in diameter.

Download the STL Files

Before you can print the various component parts of the specific version of the *BH2-OBL* that you wish to make, you must first obtain the appropriate 3D model STL files for that version.

STL Files for the BH2-OBL Body

The STL files for the components of the body of the *BH2-OBL* are listed in **Table 1**.

Table 1 – STL Files for the BH2-OBL Body	
Component Part	**Filename**
Outer Tube	Outer_Tube.stl
Inner Tube, Darkfield	DF_Inner_Tube.stl
Inner Tube, Open	Open_Inner_Tube.stl (See Note below)
Inner Tube, Closed	Closed_Inner_Tube.stl
Knurled Knob	Knurled_Knob.stl

Note: While there is an STL file for the *Open Inner Tube* for the *BH2-OBL* included in the ZIP file referenced below, this particular part can be difficult to print as-is, since it lacks sufficient contact area to maintain good bed adhesion. Rather than trying to find a way to print this difficult part, an easier way to make the insert is to instead print the *Darkfield Inner Tube* (using DF_Inner_Tube.stl) and then carefully trim away the center spokes along with the darkfield patch, using an X-Acto knife with a sharp blade.

STL Files for the BH2-OBL-CD Stop Insert Set

The STL files for the *BH2-OBL-CD* stop insert set are listed in **Table 2**.

Table 2 – STL Files for the BH2-OBL-CD Stop Inserts	
Component Part	**Filename**
Darkfield Insert, 20mm (CD)	DF_Insert_CD.stl
Oblique Darkfield Insert, 20mm (CD)	OBL_DF_Insert_CD.stl
Oblique Insert, Narrow Sector (CD)	Narrow_Sector_Insert_CD.stl
Oblique Insert, Wide Sector (CD)	Wide_Sector_Insert_CD.stl
Oblique Insert, Football (CD)	Football_Insert_AAC.stl
Oblique Insert, Crescent (CD)	Crescent_Insert_CD.stl
Oblique Insert, Small Circle (CD)	Small_Circle_Insert_CD.stl
Oblique Insert, Medium Circle (CD)	Medium_Circle_Insert_CD.stl
Oblique Insert, Large Circle (CD)	Large_Circle_Insert_CD.stl
Custom Insert, Closed (CD)	Closed_Insert_CD.stl
Custom Insert, Open (CD)	Open_Insert_CD.stl

STL Files for the BH2-OBL-AAC Stop Insert Set

The STL files for the *BH2-OBL-AAC* stop insert set are listed in **Table 3**.

Table 3 – STL Files for the BH2-OBL-AAC Stop Inserts	
Component Part	**Filename**
Darkfield Insert, 20mm (AAC)	DF_Insert_AAC.stl
Oblique Darkfield Insert, 20mm (AAC)	OBL_DF_Insert_AAC.stl
Oblique Insert, Narrow Sector (AAC)	Narrow_Sector_Insert_AAC.stl
Oblique Insert, Wide Sector (AAC)	Wide_Sector_Insert_AAC.stl
Oblique Insert, Football (AAC)	Football_Insert_CD.stl
Oblique Insert, Crescent (AAC)	Crescent_Insert_AAC.stl
Oblique Insert, Small Circle (AAC)	Small_Circle_Insert_AAC.stl
Oblique Insert, Medium Circle (AAC)	Medium_Circle_Insert_AAC.stl
Oblique Insert, Large Circle (AAC)	Large_Circle_Insert_AAC.stl
Custom Insert, Closed (AAC)	Closed_Insert_AAC.stl
Custom Insert, Open (AAC)	Open_Insert_AAC.stl

All of the STL files listed in **Table 1**, **Table 2**, and **Table 3** are included in the **BH2-OBL_STL_Files.zip** file, which is available for download at the following Google Drive location:

https://drive.google.com/drive/folders/1wKxMaP5twPII6M3lNmaLdvGt6SjgwwLo?usp=sharing

Slice the STL Files

With the necessary STL files in hand, the next step is to use *slicer* software to process the STL files, to produce GCODE files which are compatible with your specific model of 3D printer. While the exact procedure for using the slicer software is beyond the scope of this document, the following slicer settings are recommended:

- Nozzle Size: 0.4mm
- Layer Height: 0.2mm
- Shell Thickness: 3-layer
- Infill Percentage: 20% or greater

The various component parts (except for the inner tube) of the *BH2-OBL Accessory Kit* were designed such that no supports, rafts, nor brims are needed to successfully print the parts.

Print the Component Parts

Once you have created the necessary GCODE files from the STL files, the component parts can then be printed on your 3D printer. Before printing, make sure you have a standard 0.4mm nozzle installed on your printer and that the printer has been properly configured to use this nozzle. The parts may be printed using standard PLA filament (this is acceptable for most applications), but if you will be using extremely high lighting intensity, you may wish to use a filament with a higher melting point than PLA, such as ABS, Nylon, or PETG. Whichever type of filament you choose, be sure to use black (or better still, spend a few extra dollars and get a flat-black filament, if available) to reduce the potential for light reflections within the *BH2-OBL*. Once you have printed the necessary component parts, use an X-Acto knife (or similar) with a sharp blade to trim away any bumps, ridges, burrs, or stringing from the parts.

Assemble the BH2-OBL

Assemble the *BH2-OBL* per the following sections.

Test-Fit the Outer Tube in the Condenser

Before proceeding to assemble the *BH2-OBL*, you should first test the fit of the outer tube in the bottom bore of the condenser in which the *BH2-OBL* will be used. To do this, insert the outer tube into the bottom bore of the condenser it will be used in, and then remove it from the bore, paying careful attention to the insertion and extraction forces required to do so. The outer tube should go in with some friction, of course, but you do not want so much friction that the assembled *BH2-OBL* will be difficult to install or remove. If the fit seems excessively tight, use a fine-grit sandpaper or emery cloth to smooth the exterior surface of the outer tube (be sure to thoroughly remove all sanding dust) until the fit in the condenser bore is acceptable.

Preliminary Assembly of the BH2-OBL

Place the inner tube onto the work surface, with the small flange facing down (**Figure 8**, left). Next, with the large flange facing upwards, place the outer tube over the inner tube (**Figure 8**, left). The top end of the inner tube should protrude from the large flange of the outer tube (**Figure 8**, right).

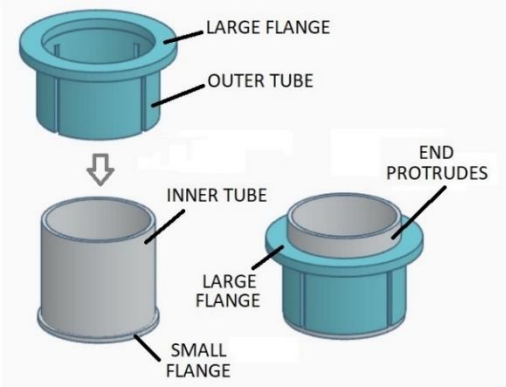

Figure 8 – Place the outer tube over the inner tube

Carefully align and press the knurled knob downwards onto the protruding end of the inner tube, pressing it as far as it will go (**Figure 9**).

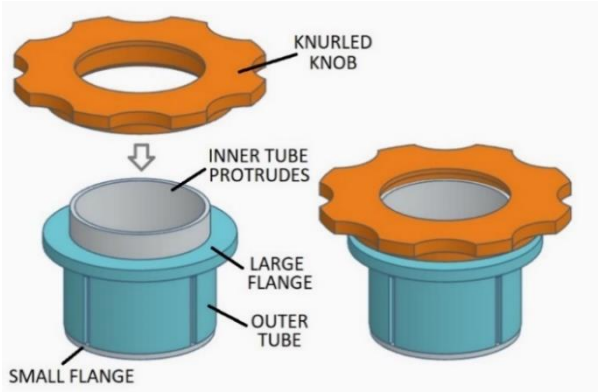

Figure 9 – Press the knurled knob into place

Test the Freedom of Motion of the Parts

Carefully grip the exterior surface of the outer tube with one hand, being careful not to squeeze it too hard, otherwise it may deflect inward and drag on the inner tube within, creating excessive friction. With the other hand, rotate the knurled knob and assess the freedom of motion of the knurled knob and inner tube, relative to the outer tube. If excess friction, sticking, or grabbing is felt, disassemble the pieces to determine the cause of the poor fit, then correct the issue and reassemble the parts per the above procedure.

Final Assembly of the BH2-OBL

After the freedom of motion of the knurled knob has been properly verified, remove the knurled knob and lightly apply cyanoacrylate adhesive (or some other suitable adhesive) to the interior circumference of the knurled knob, along the internal ridge (**Figure 10**, gray shaded area). Do not apply too much adhesive here, otherwise there will be excessive squeeze-out when the parts are re-assembled. If desired, you may also apply cyanoacrylate accelerant to the mating surface of the inner tube, to speed the curing of the adhesive.

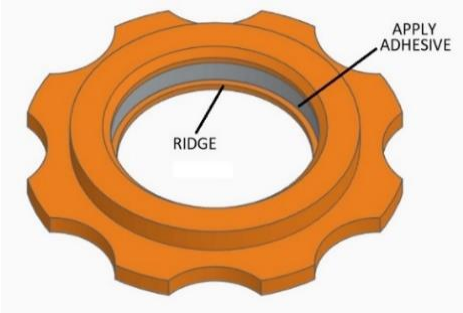

Figure 10 – Apply adhesive to the knurled knob

With the adhesive applied, carefully align and press the knurled knob onto the protruding end of the inner tube, pressing down as far as it will go (**Figure 9**) and wipe away any visible adhesive squeeze-out. Allow sufficient time for the adhesive to thoroughly cure before handling or using the *BH2-OBL*.

Test-Fit the BH2-OBL in the Condenser

The BH2-OBL should never be inserted into the Olympus BH2-CD condenser with BH2-OBL-AAC stops installed, or damage to the internal iris mechanism of the BH2-CD condenser could result.

Align and press the *BH2-OBL* (with no insert present) into the bottom bore of the condenser it will be used in (**Figure 11**), until the flange of the outer tube contacts the circular mounting dovetail on the condenser (see **Figure 12**).

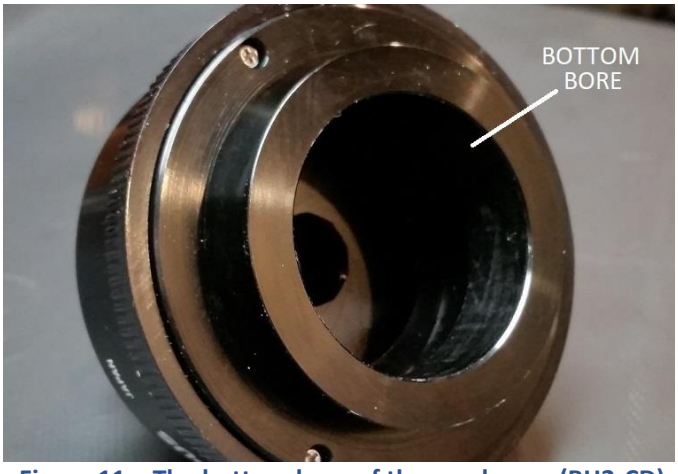

Figure 11 – The bottom bore of the condenser (BH2-CD)

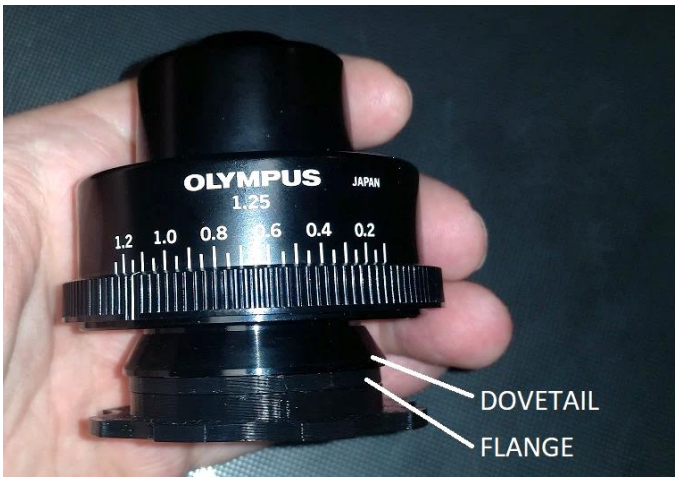

Figure 12 – BH2-OBL installed in the condenser (BH2-CD)

If the fit of the *BH2-OBL* in the condenser seems appropriate, you may proceed to use the *BH2-OBL* as described below. However, if the fit seems excessively tight, remove the *BH2-OBL* from the condenser and use a fine-grit sandpaper or emery cloth to lightly sand the exterior of the outer tube (be sure to thoroughly remove any sanding dust), repeating the test-fit and sanding steps as necessary until a proper fit in the condenser bore has been achieved. Be careful to not go too far with this step, as the fit will naturally tend to loosen with time the more often the *BH2-OBL* is installed and removed from the condenser bore during use. Note that if the *BH2-OBL* will be used on a BHTU scope, the initial fit should perhaps be a bit looser than if it were to be used on a BHS/BHT (this is due to the way that the *BH2-OBL* must be installed onto and removed from the BHTU stand as described later in this document). If the fit in the bore is found to be loose (or if it later becomes loose due to wear), simply apply some black vinyl electrical tape to the exterior surface of the outer tube to tighten the fit in the bore.

How to Use the BH2-OBL

The procedure for using the *BH2-OBL* is described in the sections below.

A Few Words of Caution

Due to the close proximity of the stop inserts of the *BH2-OBL* to the iris mechanism within the condenser, it is critical that the inserts remain properly engaged within the inner tube of the *BH2-OBL* while the *BH2-OBL* is installed in the microscope condenser, to prevent damage to the fragile iris mechanism within the condenser. It is strongly recommended that once you find a specific configuration that you wish to use, create a dedicated *BH2-OBL* body for this configuration, and use cyanoacrylate adhesive (or some other suitable adhesive) to securely bond the insert into the inner

tube of the *BH2-OBL* body. This will eliminate the risk of damage to the condenser caused by a displaced insert.

Do not adjust the aperture control ring of the condenser while the BH2-OBL is installed in the condenser. Always leave the aperture diaphragm in the wide-open position while the BH2-OBL is installed.

Setup the Microscope for Köhler Illumination

Before installing the *BH2-OBL* into your condenser, perform a routine Köhler setup with the objective lens you wish to use, to ensure that the condenser is axially centered within the illumination path of the microscope.

Configure the BH2-OBL for the Desired Mode

Place the desired stop insert from the appropriate insert set (*BH2-OBL-CD* or *BH2-OBL-AAC*) into the upper end of the inner tube of the *BH2-OBL* (**Figure 13**). Note that if you are using the open insert as a carrier for a custom 28.4mm stop or filter, the custom stop or filter must be secured in the open insert in some manner, otherwise the stop or filter will fall out of the carrier during use (since it will be upside-down when the *BH2-OBL* is inserted into the condenser bore).

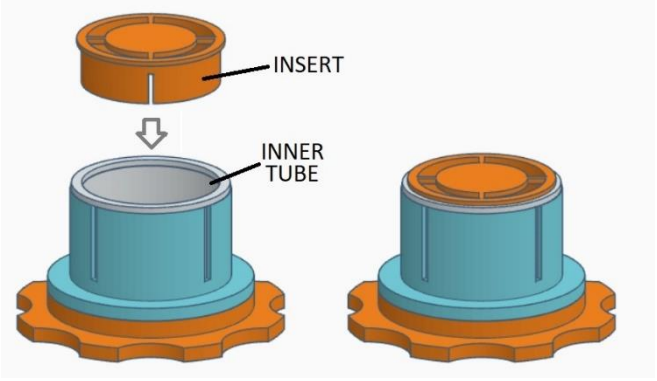

Figure 13 – Place the desired insert into the BH2-OBL

How to Install the BH2-OBL into the Condenser

The BH2-OBL should never be inserted into an Olympus BH2-CD condenser with a BH2-OBL-AAC insert installed, or damage to the internal iris mechanism of the BH2-CD condenser could result.

The proper method to install the *BH2-OBL* into the condenser of a BH-2 microscope depends on which specific BH-2 microscope model you have.

INSTALLATION ON BHS/BHT SCOPES

To install the *BH2-OBL* into the condenser on a BHS or BHT microscope, use the procedure described below.

1. Set the nosepiece turret to the lowest power objective.
2. Release the stage-height preset stop if it is set.
3. Use the coarse-focus knobs to raise the stage as high as it will go.
4. Use the condenser focus knob to lower the condenser as low as it will go.
5. Loosen the condenser locking thumbscrew and remove the condenser from the substage assembly of the BHS/BHT stand.
6. Carefully align and press the *BH2-OBL* (with insert fitted) into the bottom bore of the condenser, making sure that the large flange of the outer tube of the *BH2-OBL* contacts the circular mounting dovetail of the condenser.
7. Reinstall the condenser (with the *BH2-OBL* fitted) back onto the substage assembly of the BHS/BHT stand and secure it in place with the condenser locking thumbscrew.
8. Use the condenser focus knob to return the condenser to its normal position.
9. Use the coarse-focus knobs to return the stage to its normal position.

INSTALLATION ON BHTU SCOPES

To install the *BH2-OBL* into the condenser on a BHTU microscope, use the procedure described below. Note that the above procedure for the BHS/BHT will not work with the BHTU, since there is insufficient substage clearance on the BHTU to install the condenser with the *BH2-OBL* fitted.

1. Set the nosepiece turret to the lowest-power objective.
2. Release the stage-height preset stop if it is set.
3. Use the coarse-focus knobs to raise the stage as high as it will go.
4. Use the condenser focus knob to raise the condenser as high as it will go.
5. With the condenser still mounted onto the substage assembly of the BHTU stand, physically support the condenser with one hand and very carefully align and press the *BH2-OBL* (with insert fitted) into the bottom bore of the condenser with the other hand, making sure that the large flange of the outer tube of the *BH2-OBL* contacts the circular mounting dovetail of the condenser. It is critical that you properly support the condenser while inserting the *BH2-OBL*, otherwise the insertion forces will transfer to the substage assembly, which can result in damage to the fragile gear rack in the condenser height mechanism.
6. Use the condenser focus knob to return the condenser to its normal position.

7. Use the coarse-focus knobs to return the stage to its normal position.

ALTERNATE INSTALLATION ON BHTU SCOPES

If for any reason you feel that the *BH2-OBL* cannot be safely installed while the condenser is mounted onto the BHTU stand, use the procedure described below instead.

1. Set the nosepiece turret to a blank objective position (if necessary, remove the highest-power objective to provide a blank position).
2. Release the stage-height preset stop if it is set.
3. Use the coarse-focus knobs to raise the stage as high as it will go.
4. Use the condenser focus knob to lower the condenser as low as it will go.
5. Loosen the condenser locking thumbscrew and remove the condenser from the substage assembly of the BHTU stand.
6. Carefully align and press the *BH2-OBL* (with insert fitted) into the bottom bore of the condenser, making sure that the large flange of the outer tube of the *BH2-OBL* contacts the circular mounting dovetail of the condenser.
7. Use a 3mm hex tool to loosen the lock screw securing the substage assembly onto the focus block of the BHTU stand.
8. With the locking screw loosened, very carefully raise the substage assembly on the focus block until the stage is close to, but does not touch, the closest objective lens.
9. While holding the substage assembly to keep it from moving, snug the lock screw down to secure the substage assembly in this new position.
10. Reinstall the condenser (with the *BH2-OBL* fitted) onto the substage assembly of the BHTU stand and use the condenser locking thumbscrew to secure it in place.
11. Use the condenser focus knob to raise the condenser to its normal position.
12. Use a 3mm hex tool to loosen the substage lock screw once again and lower the substage assembly back to its original position on the focus block.
13. While holding the substage assembly to keep it from moving, snug the lock screw down to secure the substage assembly in its original position.
14. Use the coarse-focus knobs to return the stage to its normal position.
15. Reinstall the objective lens, if applicable.

How to Remove the BH2-OBL from the Condenser

The proper method to remove the *BH2-OBL* from the condenser of a BH-2 microscope depends on which specific BH-2 model you have.

REMOVAL FROM BHS/BHT SCOPES

To remove the *BH2-OBL* from the condenser of a BHS or BHT microscope, use the procedure described below.

1. Set the nosepiece turret to the lowest power objective.
2. Release the stage-height preset stop if it is set.
3. Use the coarse-focus knobs to raise the stage as high as it will go.
4. Use the condenser focus knob to lower the condenser as low as it will go.
5. Loosen the condenser locking thumbscrew and remove the condenser (with the *BH2-OBL* fitted) from the substage assembly of the BHS/BHT stand.
6. Grasp the knurled knob of the *BH2-OBL* and carefully remove the *BH2-OBL* from within the bore of the condenser.
7. Reinstall the condenser back onto the substage assembly of the BHS/BHT stand and secure it in place with the condenser locking thumbscrew.
8. Use the condenser focus knob to return the condenser to its normal position.
9. Use the coarse-focus knobs to return the stage to its normal position.

REMOVAL FROM BHTU SCOPES

To remove the *BH2-OBL* from the condenser of a BHTU microscope, use the procedure described below. Note that the above procedure for the BHS/BHT will not work with the BHTU, since there is insufficient substage clearance on the BHTU to remove the condenser with the BH2-OBL fitted.

1. Set the nosepiece turret to the lowest-power objective.
2. Release the stage-height preset stop if it is set.
3. Use the coarse-focus knobs to raise the stage as high as it will go.
4. Use the condenser focus knob to raise the condenser as far as it will go.
5. With the condenser still mounted onto the substage assembly of the BHTU stand, physically support the condenser with one hand and grasp the knurled knob of the *BH2-OBL* with the other hand, and then very carefully remove the *BH2-OBL* from the bore of the condenser. It is critical that you properly support the condenser while removing the *BH2-OBL*, otherwise

the extraction forces will transfer to the substage assembly, which can damage the fragile gear rack in the condenser height mechanism.

6. Use the condenser focus knob to return the condenser to its normal position.
7. Use the coarse-focus knobs to return the stage to its normal position.

ALTERNATE REMOVAL FROM BHTU SCOPES

If for any reason you feel that the *BH2-OBL* cannot be safely removed while the condenser is mounted onto the BHTU stand, use the procedure described below instead.

1. Set the nosepiece turret to a blank objective position (if necessary, remove the highest-power objective to provide a blank position).
2. Release the stage-height preset stop if it is set.
3. Use the coarse-focus knobs to raise the stage as high as it will go.
4. Use a 3mm hex tool to loosen the lock screw securing the substage assembly onto the focus block of the BHTU stand.
5. With this screw loosened, very carefully raise the substage assembly on the focus block until the stage is close to, but does not touch, the closest objective lens.
6. While holding the substage assembly to keep it from moving, snug the lock screw down to secure the substage assembly in this new position.
7. Use the condenser focus knob to lower the condenser as low as it will go.
8. Loosen the condenser locking thumbscrew and remove the condenser (with the *BH2-OBL* fitted) from the substage assembly of the BHTU stand.
9. Grasp the knurled knob of the *BH2-OBL* and very carefully remove the *BH2-OBL* from within the bore of the condenser.
10. Reinstall the condenser onto the substage assembly of the BHTU stand and use the condenser locking thumbscrew to secure it in place.
11. Use the condenser focus knob to raise the condenser to its normal position.
12. Use a 3mm hex tool to loosen the substage lock screw once again and lower the substage assembly back to its original position on the focus block.
13. While holding the substage assembly to keep it from moving, snug the lock screw down to secure the substage assembly in its original position.
14. Use the coarse-focus knobs to return the stage to its normal position.
15. Reinstall the objective lens, if applicable.

Tips for Using the BH2-OBL Accessory Kit

There are many online sites geared towards amateur microscopy, and these sites have a great many references that describe various methods, tips, and tricks for using oblique and darkfield illumination. That information is readily available and as such will not be repeated here. Listed below are a few basic things to get you started when using the *BH2-OBL* on your BH-2.

- Always set the aperture diaphragm in the condenser to the wide-open position before installing the *BH2-OBL*.
- Be sure to leave the aperture diaphragm in the condenser wide open while the *BH2-OBL* is installed in the condenser.
- Install the proper version (*BH2-OBL-CD* or *BH2-OBL-AAC*) of the desired insert type into the *BH2-OBL* before installing the *BH2-OBL* into the microscope condenser.
- If using a custom stop in the open insert, you must secure the custom stop to the open insert to prevent it from falling out during use.
- Experiment with the radial positioning of the oblique aperture (as controlled via the knurled knob on the *BH2-OBL*), to obtain the desired appearance of the specimen image.
- If an insert fits loosely into the *BH2-OBL*, apply black vinyl electrical tape (or similar) as necessary to the mating surface of the insert to tighten the fit.
- If the *BH2-OBL* fits loosely in the bore of the microscope condenser, apply black vinyl electrical tape (or similar) as necessary to the exterior surface of the outer tube, to tighten the fit.

An Alternative Accessory Kit

The primary purpose of the *BH2-OBL Accessory Kit* is to provide oblique illumination to Olympus BH-2 scopes. However, in addition to oblique illumination, the *BH2-OBL* also includes sufficient flexibility to provide the BH-2 with basic darkfield or even Rheinberg illumination, with some limitations. Since the *BH2-OBL* was intended primarily for oblique lighting, there was an up-front design requirement that the *BH2-OBL* include a mechanism to allow the user to vary the radial positioning of the oblique aperture illuminating the specimen. Accordingly, the design was implemented with a movable inner tube, concentric within a fixed outer tube, and with the inner tube attached to a knurled knob on the bottom of the unit. This knob

allows the user to spin the oblique stop about the optical axis of the condenser while simultaneously viewing through the eyepieces. The presence of this knob beneath the condenser complicates the installation of the *BH2-OBL*, especially on BHTU scopes, where substage space is limited. Also, the concentric construction of the *BH2-OBL* limits the size of custom stops or filters that the *BH2-OBL* can accept. In light of these limitations, it should be noted that there is a simpler and more versatile accessory kit available for Olympus BH-2 scopes, which is better optimized for both darkfield and Rheinberg illumination. This accessory kit (the *BH2-DFR*) is described in a separate document (***A Darkfield/Rheinberg Accessory Kit for Olympus BH-2 Microscopes***) and is generally preferable to the *BH2-OBL* when darkfield or Rheinberg capabilities are desired. The *BH2-DFR* is especially preferable over the *BH2-OBL* for darkfield or Rheinberg on BHTU scopes.

How To Contact the Author

Please feel free to direct any questions or comments regarding this document (or BH-2 microscopes in general) to the author as listed on the cover page of this document.