

## Using a digital SLR or mirrorless camera with an Olympus BH-2 compound microscope

### Introduction

Olympus made it easy to use a trinocular BH-2 microscope with their OM 35 mm SLR cameras by adding just a clear 1-12 focusing screen, a 2.5× photo eyepiece and a simple camera adapter.

The OM film cameras are now obsolete, but simple lens adapters allow Canon EOS, Sony NEX, Four Thirds or Micro Four Thirds digital SLR and mirrorless cameras to be used instead, bringing good-quality digital imaging to the BH-2 microscopes. Alternative camera adapters allow Minolta, Nikon, Pentax, Sigma, Sony  $\alpha$  and other digital cameras to be used. Any trinocular version of the BH-2 compound microscope is suitable, including the BHS, BHSU, BHT and BHTU biological models, the BHSP and BHTP polarising models and the BHM, BHMJ, BHMJL and BHSM metallurgical models.



Starting from the top, you need the following items:

- [Camera body](#)
- [Lens adapter](#)
- [Camera adapter](#)
- [Photo eyepiece](#)
- [Finder eyepiece](#) (optional)
- [Trinocular head](#)

The BH-2 microscope was discontinued around 1993, and so most of the items you need (including the Photomicro Adapter L, the NFK photo eyepieces and the BH2-TR30 trinocular head) have also been discontinued. The best places to find them are eBay and microscope dealers who sell used equipment.

Remote control software makes photomicrography much easier. Instead of peering through the viewfinder or using the small LED screen on the camera, you can use your computer screen to check focus, compose, set white balance, adjust exposure and take the photograph. Focus stacking software increases depth of field, which often makes photomicrographs appear sharper.

- [Remote control software](#)
- [Focus stacking software](#)

### Camera bodies

You do not need a lens on the camera, because Olympus designed their [photo eyepieces](#) to project an image directly onto the film or sensor. The best digital cameras to use as

replacements for an Olympus OM have a 36×24 mm full-frame sensor, allowing you to carry on using the same NFK 2.5× photo eyepiece and 35 WHK 10×/20 L [finder eyepiece](#). Examples include the Canon EOS 5D Mark II, 5D Mark III, 5D Mark IV, 6D and 6D Mark II SLRs and the mirrorless EOS R and RP. For a table of suitable Canon cameras, see [Digital replacements for Olympus OM 35 mm cameras](#).

A cheaper option is a digital SLR with an APS-C sensor (22.2×14.8 mm), such as the Canon EOS 7D, 40D, 50D, 600D (Rebel T3i) and 1100D (Rebel T3), but the smaller sensor results in a significantly smaller field of view unless a very expensive NFK 1.67× photo eyepiece is used. It is possible to use digital cameras with a Four Thirds sensor (17.3×13.0 mm), but even with an NFK 1.67× photo eyepiece the camera's field of view is substantially smaller than the viewing eyepieces.

Vibration from the camera's mirror and shutter can be a problem when taking photographs through a microscope. Traditional solutions include electronic flash, long exposure times, mirror pre-release, and stands that support the camera independently of the microscope. Canon EOS digital cameras from the 5D Mark II, 6D, 7D, 40D, 450D and 1000D onwards have a Live View Silent Shooting mode that makes them particularly suitable for photomicrography. In this mode, vibration is almost eliminated, because the exposure is started electronically while the mirror is already raised and the shutter is already open. This is also referred to as EFSC or electronic first shutter curtain. EOS cameras also come with EOS Utility [remote control software](#) that allows you to control the camera via a USB connection from a computer, lets you use the computer screen to check focus and composition, and allows images to be saved directly to the computer.

The camera body is connected via a [lens adapter](#) to the [camera adapter](#).

### Lens adapters

The lens adapter connects the camera body to the [camera adapter](#), and ensures that the digital sensor is located in exactly the same plane as the film in an OM camera.

For Canon EOS camera bodies, new lens adapters are readily available on eBay so that you can fit one of these bodies to the top of the Photomicro Adapter L instead of an Olympus OM camera. For the digital SLRs, the adapter converts the OM bayonet on the Adapter L to an EF bayonet and is 2.0 mm thick to compensate for the difference in registration between OM and EOS bodies. For the R mirrorless cameras, the adapter converts the OM bayonet on the Adapter L to an R bayonet and adds the necessary 26.0 mm extension.



*Front and rear of adapter for mounting an OM lens on a Canon EOS SLR camera*

There are three types of lens adapter for using Canon EOS SLR bodies – no chip, AF confirm chip and EMF chip. The features of the three adapters are:

	no chip	AF confirm	EMF
M (manual exposure, user sets the shutter speed)	Yes	Yes	Yes
Av (auto exposure, camera sets the shutter speed)	Yes	Yes	Yes
Spot, partial, centre-weighted and evaluative metering	Yes	Yes	Yes
Confirmation of manual focus by beeping and by flashing one or more of the AF points in the viewfinder	No	Yes	Yes
EXIF lens data fixed at 0 mm for focal length and F/0 for aperture	Yes	No	No
EXIF lens data fixed, e.g. 50 mm for focal length and F/1.4 for aperture	No	Yes	No
EXIF lens data can be changed by user	No	No	Yes

For Sony NEX, Four Thirds and Micro Four Thirds camera bodies, new lens adapters are readily available on eBay to enable these bodies to be fitted to the top of the Photomicro Adapter L instead of an Olympus OM camera.

For Minolta AF/Sony  $\alpha$  camera bodies, there are new lens adapters on eBay that might be suitable for use with a Photomicro Adapter L. The adapters are thick but they include a lens, so they might allow OM lenses to focus to infinity; if this is the case, then they probably are suitable.

For Nikon F camera bodies, it is not possible to make a lens adapter, but it is possible to remove the OM mount from the Photomicro Adapter L and replace it with a Nikon F mount that is 0.5 mm thinner.



*Replacement camera mount for Nikon F cameras on Photomicro Adapter L*

For Canon EOS, Minolta, Nikon, Olympus E, Panasonic, Pentax, Sigma, Sony  $\alpha$ , Sony NEX and other camera bodies, you can buy new T-2 lens adapters on eBay that let you use these bodies with one of the [alternative camera adapters](#) that have a T-2 fitting on top.

### Camera adapters

Olympus produced the [Photomicro Adapter L](#) to allow their Olympus OM 35 mm film cameras to be used for photomicrography with trinocular versions of their BH-2 compound microscopes. [Lens adapters](#) are easily available on eBay to convert the OM rear lens fitting on the top of the Adapter L so that Canon EOS, Four Thirds and other shallow-bodied cameras can be used instead of OM cameras, with the digital sensor located in exactly the same plane as the film. It is not possible to make an adapter for Nikon F cameras, but you can remove the OM mount and replace it with one for Nikon F cameras.

The bottom of the Adapter L clamps on to the circular dovetail on [trinocular heads](#) for BH-2 microscopes.

Olympus changed the colour of the Adapter L to cream to match the BH-2 microscopes; it was originally finished in grey to match the older BH microscopes.



### Alternative camera adapters

If you want to use a Pentax or other deep-bodied digital SLR, it would be difficult to modify the Adapter L to accept T-2 mounts while retaining parfocality. However, there are at least three sources of alternative adapters that attach to the Olympus 38 mm circular dovetail at the bottom and take a T-2 mount at the top.

1) Richard J. Kinch ([Olympus 38mm Dovetail to T-mount Adapter](#)) makes an adapter that maintains the proper 150.0 mm distance from the lip on which the top section of an NFK eyepiece rests to the plane of the sensor.



*Richard J. Kinch's adapter*

2) Martin Microscopes produce their MBH2T adapter; they do not list it on their website so you need to [contact Martin Microscopes](#).

3) Diagnostic Instruments have discontinued their PA1-10A adapter.



*Diagnostic Instruments PA1-10A adapter*

### Photo eyepieces

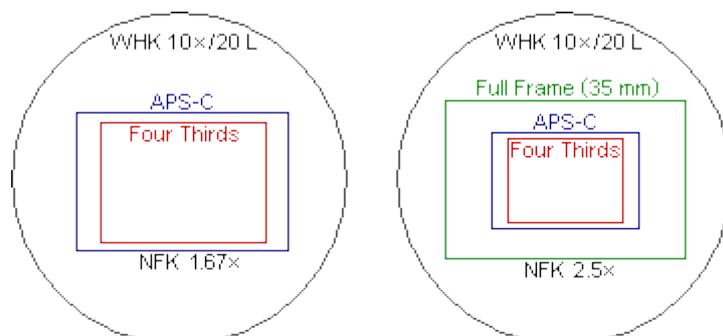
To project the image produced by the objective onto the sensor in the camera body, special photo eyepieces that sit inside the circular dovetail on the [trinocular head](#) are used, not the viewing eyepieces.

Olympus designed the [NFK photo eyepieces](#) for photomicrography with the LB (long barrel) objectives that they supplied with the BH-2 microscopes, including the DPlan, SPlan, SPlan Apo, MSPlan and Neo SPlan ranges. These objectives have a 45 mm parfocal distance.



For digital cameras with a full-frame sensor (36×24 mm, diagonal 43.3 mm), such as the Canon EOS 5D Mark II, 5D Mark III, 6D, RP and R, the most appropriate photo eyepiece is the NFK 2.5×. With a 10× objective and WHK 10×/20L eyepieces, the field of view is 1.98 mm diameter. With a 10× objective, an NFK 2.5× photo eyepiece and a Canon EOS 5D Mark II, the diagonal field of view is 1.74 mm, and the rectangular field of view is 1.45 × 0.97 mm.

For digital SLRs with an APS-C sensor (22.2×14.8 mm, diagonal 26.7 mm), such as the Canon EOS 7D, 40D, 50D and 550D, the most appropriate photo eyepiece is the NFK 1.67×. Unfortunately, these are uncommon and expensive. The NFK 2.5× can be used, but the small sensor significantly restricts the field of view.



*Camera image areas with Olympus NFK 1.67× and 2.5× photo eyepieces, relative to WHK 10×/20 L viewing eyepieces*

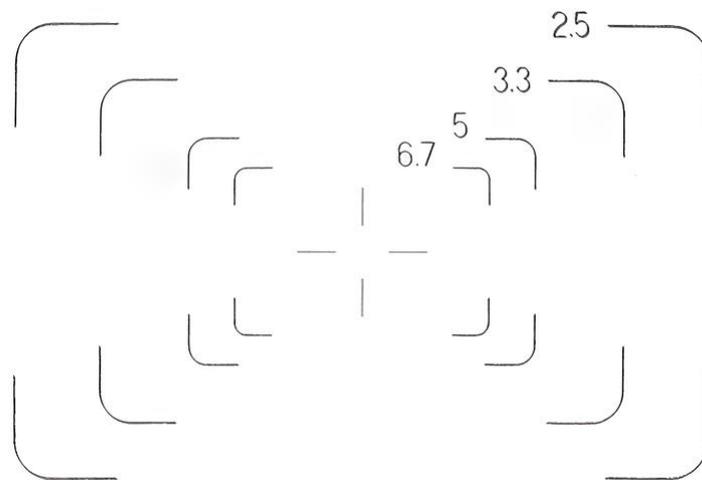
For digital cameras with a Four Thirds sensor (17.3×13.0 mm, diagonal 21.6 mm), the most appropriate photo eyepiece is also the NFK 1.67×, but the small sensor means that the camera's field of view is substantially smaller than the viewing eyepieces.

The NFK 3.3×, 5× and 6.7× photo eyepieces can be used when higher magnification (with a correspondingly smaller field of view) is required.

None of the photo eyepieces can cover the field of view through the BH2-SWTR30 superwide trinocular head.

### Finder eyepieces

Olympus made 10× finder eyepieces that you could use in the right-hand eyepiece tube to show the rectangular field of view for the NFK 2.5×, 3.3×, 5× and 6.7× photo eyepieces with 35 mm film, and of course these work perfectly with full-frame digital SLRs.



*Fields of view for NFK 2.5×, 3.3×, 5× and 6.7× photo eyepieces*

There were three versions, for the WHK, WK and SWHK series of eyepieces. The WHK version is marked 35 WHK 10×/20 L, the WK version is marked 35 WK 10×/20 L and the SWHK version is marked 35 SWHK 10× L. You use a normal viewing eyepiece in the left-hand eyepiece tube.

A small locating screw fits into a slot in the right-hand eyepiece tube and prevents the lower part of the eyepiece from rotating. This is necessary to stop the rectangles rotating out of alignment with the camera, and to allow the top part to be rotated for focusing.

The finder eyepieces include double cross hairs in the centre; rotate the top part of the eyepiece until you can clearly see the fine double lines of the cross hairs. Once you have done this, the subject plane that is in focus at the same time as the cross hairs will also be in focus on the film or sensor.

The finder eyepieces can be convenient, because they let you check what the camera will see without moving your head to look through the camera or at the computer screen, but they are not essential.

## Trinocular heads

Trinocular heads have a pair of inclined tubes for binocular viewing plus a third vertical tube that takes an NFK [photo eyepiece](#).

Olympus made three trinocular heads for the BH-2 microscope, and they all incorporate the 38 mm circular dovetail for attaching a [camera adapter](#). The common trinocular head is the BH2-TR30. The other heads are the superwide BH2-SWTR30 and the tilting BH2-TTR, which are uncommon and very expensive.



*Olympus BH2-TR30 trinocular head*

With the BH2-TR30 and BH2-TTR trinocular heads, the image seen through the right viewing eyepiece should automatically be in focus at the same time as the image on the sensor of the digital camera. The viewing eyepiece tube for the right eye is not adjustable, and has a slot for aligning a [finder eyepiece](#). The viewing eyepiece tube for the left eye is adjustable, so that you can bring the image seen through the left eyepiece into focus with the image seen through the right eyepiece.

If the image seen through the right viewing eyepiece is not in focus at the same time as the image on the sensor of the digital camera, try to obtain an eyepiece that was intended for use with a removable reticle. These have a focusing helix that was intended to make sure that the markings on the reticle could be seen clearly, but without a reticle you can use them to make the camera and the right eyepiece parfocal. First, focus the image from a low-power objective seen through the camera. Then, without touching the microscope's coarse or fine focus knobs, adjust the right eyepiece to bring the image into focus. Then adjust the left eyepiece tube to bring that image into focus too. Suitable adjustable eyepieces are marked -H, for example WHK 10x/20 L -H or WK 10x/20 L -H.

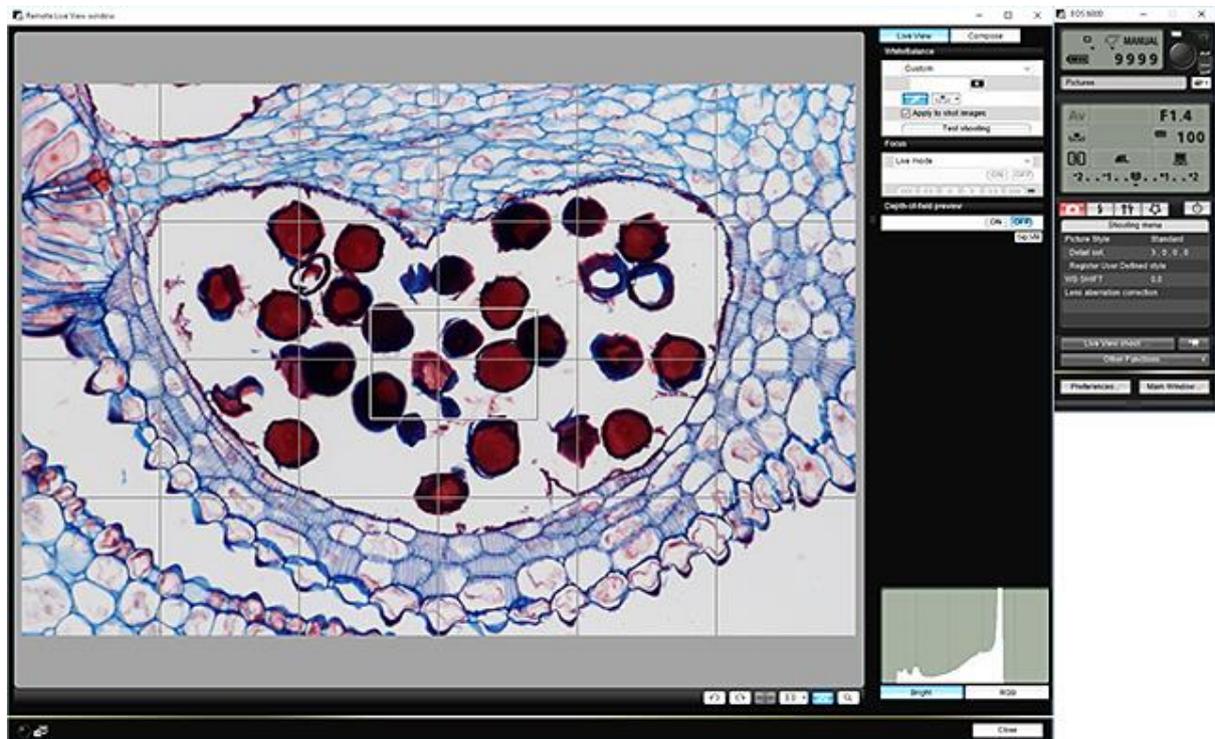
On the BH2-SWTR30 superwide trinocular head, both eyepiece tubes are fixed but the superwide eyepieces incorporate dioptric adjustment. To make the viewing eyepieces parfocal with the camera, first focus the image from a low-power objective seen through

the camera. Then, without touching the microscope's coarse or fine focus knobs, adjust the left and right viewing eyepieces to bring the images seen through the eyepieces into focus.

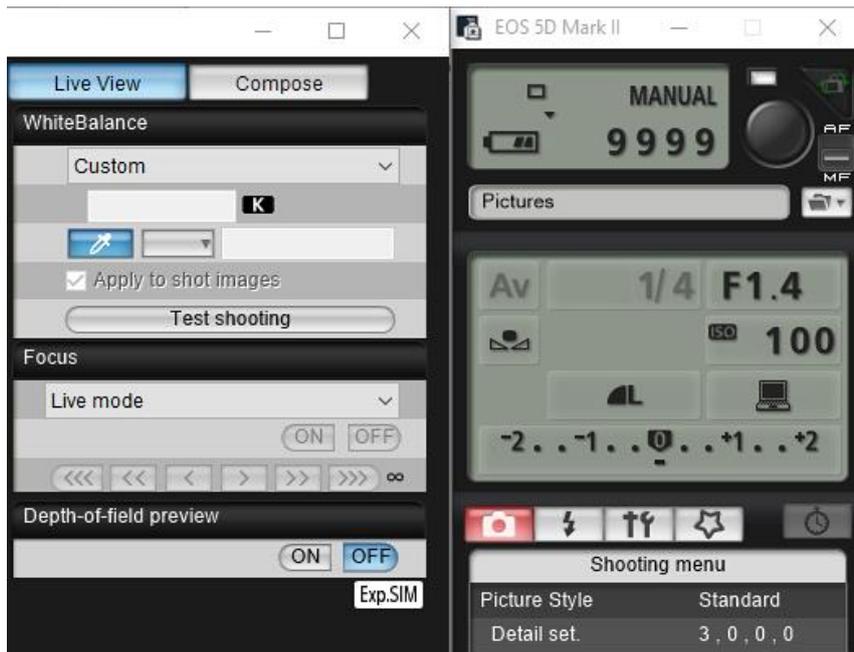
You can use trinocular heads for the older BH microscopes on a BH-2, but they need a [PM-ADF eyepiece adapter](#) to provide the circular dovetail.

### Remote control software

To make the best use of a digital SLR or mirrorless camera, you need to abandon the way you worked with 35 mm film; you no longer need to peer through the camera's viewfinder or turn knobs, dials and rings, instead you control everything from your computer. With remote control software such as [EOS Utility](#) for Canon digital SLR and mirrorless cameras, you connect the camera to a USB port on your computer. Then you can display the Live View image from the camera's sensor on your computer screen so that you can check focus, compose, adjust white balance and exposure, and take the photograph. The software saves the images on your hard drive, so you do not need to worry about filling up a memory card. There is no need to touch the camera except to turn it on and off.



Canon EOS Utility software

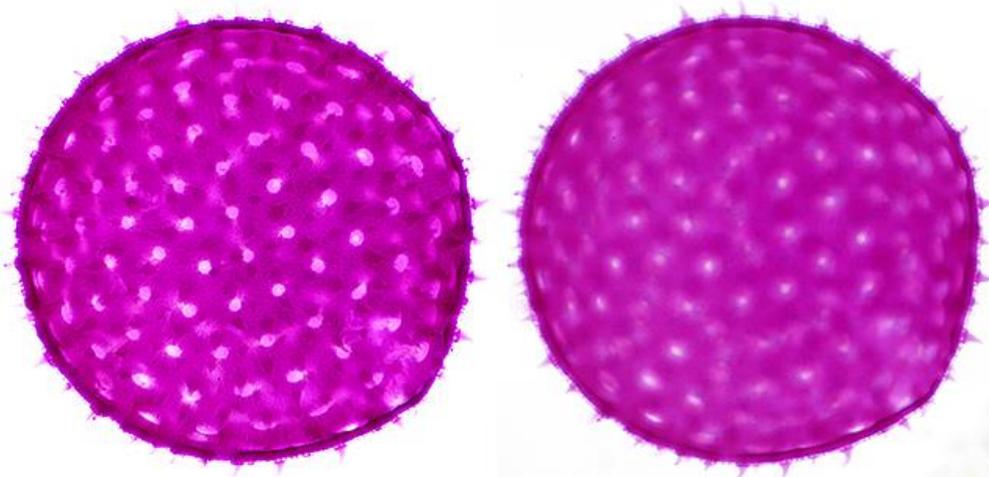


*Camera and image controls in Canon EOS Utility software*

Using the camera in Live View drains its batteries quite quickly, so it is a good idea to use a mains adapter.

### Focus stacking software

A common problem when starting photomicrography is a perceived lack of sharpness in the photos, when compared with the view through the binocular eyepieces. Often, the cause is not a fault with your equipment or technique, but shallow depth of field. The solution is to take a series of photos focused at different points, and then use focus stacking software that selects the sharpest parts of each image and combines them to produce an image with good depth of field.



*Mallow pollen grain, stack of 12 images (left) and single image (right)*

The two most popular stacking programs are [Zerene Stacker](#) and [Helicon Focus](#).

## Summary

The following table summarises the best options for various combinations of cameras and microscopes.

<a href="#"><u>Cameras</u></a>	EOS full-frame	EOS APS-C	Four Thirds	Nikon APS-C
<a href="#"><u>Lens adapter</u></a>	OM/EOS adapter	OM/EOS adapter	OM/Four Thirds adapter	Nikon T-2 adapter
<a href="#"><u>Camera adapter</u></a>	Adapter L	Adapter L	Adapter L	Richard J. Kinch
<a href="#"><u>Eyepiece</u></a>	NFK 2.5×	NFK 1.67×	NFK 1.67×	NFK 1.67×
<a href="#"><u>Head</u></a>	BH2-TR30	BH2-TR30	BH2-TR30	BH2-TR30

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Last updated 19th January 2021