Cover Glass

- An Olympus objective engraved "160/0.17" requires a cover glass of 0.17mm thickness. If the numerical aperture of the objective is 0.7 or higher (except immersion objectives) and no correction collar is provided, the resolving power deteriorates to a great extent if cover glass thickness deviates from the above listed value.

  NOTE: In some countries a 0.17mm cover glass corresponds to a designation of #1½.

- A cover glass (0.4 mm thick) for blood counting, etc. can be used with Olympus objectives except D Plan 40X, S Plan Apo 40X and S Plan 100X.

Specimen Slide

- Specimen slides 0.8 mm to 1.5 mm thick are recommended for Olympus objectives.
- Specimen slides 0.8 mm to 1.2 mm thick are recommended for the darkfield condenser and the differential interference contrast condenser.

3) Bring the portion of the specimen for observation into the light path by means of the low drive control knobs. (Fig. 8)

★ **Tighten the stage clamping screw ① in the microscope front.**

Fig. 8

Stage

- The specimen holder can accommodate two standard specimen slides simultaneously.
- The specimen holder is removable to obtain a large unobstructed stage surface to hold specimens up to 55 mm x 85 mm.
- To rotate the stage loosen the stage clamping screw ① and holding this screw, rotate the stage into the desired direciton. (Fig. 9)

◎ Stage clips for use with immersion objectives. (Fig. 10)
A pair of stage clips are optionally available to hold the specimen on the stage, eliminating a specimen drag caused by immersion oil between slide and stage surface. The clips can be inserted into the holes ① provided on the specimen holder.

Fig. 9

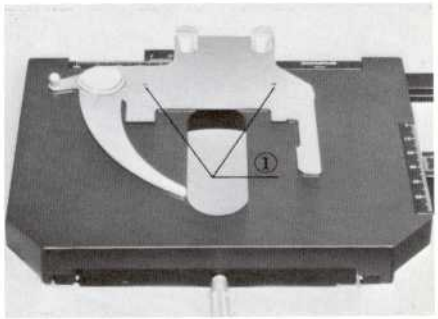


Fig. 10

C. Observation Tube

1. Interpupillary Distance Adjustment

1) Click the 10X objective into position.
2) Looking through the eyepieces with both eyes, adjust the interpupillary distance of the binocular tube by adjusting the knurled dovetail slides ① of the right and left eyepiece tubes with both hands until perfect binocular vision is obtained. (Fig. 11)

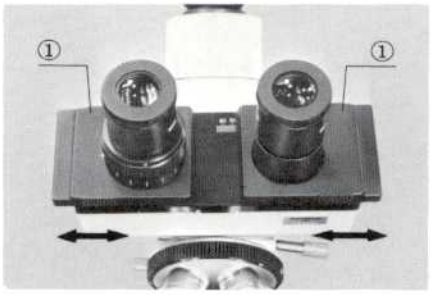


Fig. 11

2. Diopter Adjustment

1) Look at the image through the right eyepiece with your right eye and focus on the specimen with the fine adjustment knobs.
2) Next, look at the image through the left eyepiece with your left eye and rotate the diopter adjustment ring ① to focus on the specimen without using the coarse and fine adjustment knobs. (Fig. 12)

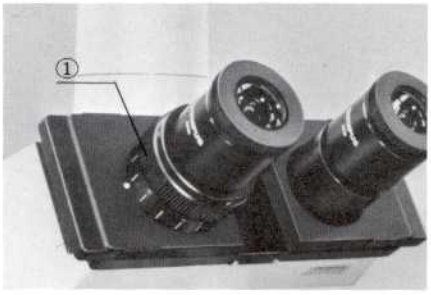


Fig. 12

3. Light Path Selection

1) The trinocular tube is provided with a light path selector knob to direct the light to the observation tube and/or to the photo tube in 3 positions. (Fig. 13)

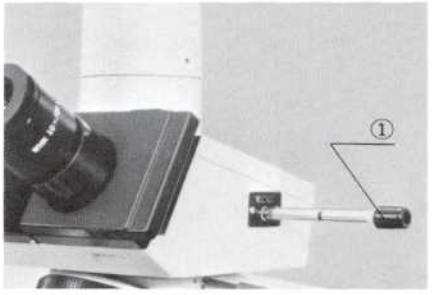


Fig. 13

	Knob Position		
	Pushed in all the way (V)	Pulled out halfway (C. V.)	Pulled out all the way (C)
Amount of light	100% into binocular tube	20% into binocular tube 80% into photo tube	100% into photo tube
Application	① Observation ② Dark specimens	① Observation of excessively bright specimens ② Photomicrography (focusing through the binocular tube)	Photomicrography of dark specimens

The indicator plate is provided at the knob port to summarize the usage of the above table; it can be consulted before operating the knob.

V: Viewer (white letter)
CV: Camera & viewer (yellow-green letters)
C: Camera (red letter)

The colors of the letters correspond with the color bands on the knob shaft.

D. Condenser Adjustment

1. Condenser Centration

1) Stop down the field iris diaphragm with knurled ring ① by rotating in the direction of the arrow. (Fig. 14)
2) Use the condenser height adjustment knob ② to move the condenser up and down until an image of the field diaphragm can be seen clearly in the eyepieces. The rotation of the knob in the direction of the arrow lowers the condenser.

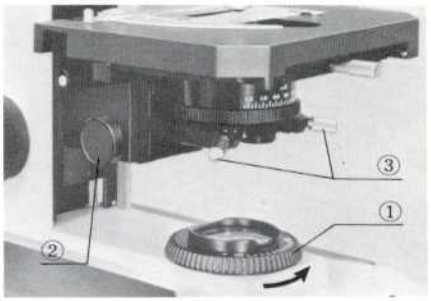


Fig. 14

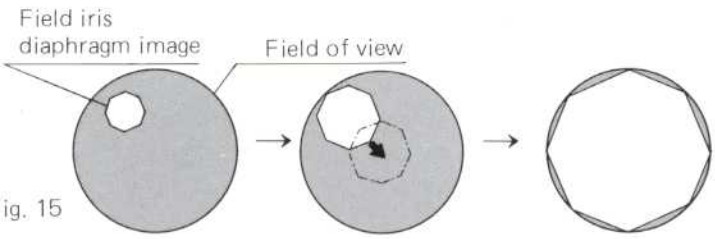


Fig. 15

3) Bring the field iris diaphragm image into the center of the field of view with the two condenser centering knobs ③. (Fig. 14)
4) Widen the diameter of the iris diaphragm progressively. If the polygonal image of the iris diaphragm becomes inscribed in the field it means that the field diaphragm is centered. (Fig. 15)

Field Iris Diaphragm

- The field iris diaphragm controls the diameter of the ray bundle impining on the specimen surface and therefore, by stopping down the field diaphragm until it is slightly larger than the field of view, it can reduce stray light, which in turn increases image definition and contrast.

Aperture Iris Diaphragm

- In order to achieve optimum objective performance, the opening of the aperture iris diaphragm should be matched to the numerical aperture of the objective in use. It is often preferable, however, to stop down the aperture diaphragm slightly more than indicated by the objective N.A. This will result in better image contrast, increased depth of focus and a flatter field.
- After completing focus adjustment, remove one of the eyepieces from the observation tube and look into the empty eyepiece tube. As you stop down the aperture iris diaphragm, the image of the iris diaphragm can be seen in the objective pupil. Adjust the opening of the diaphragm to match the N.A. of the objective in use. If the specimen is low in contrast, it is recommended to stop down to 70% ~ 80% of the objective N.A. (Fig. 16)

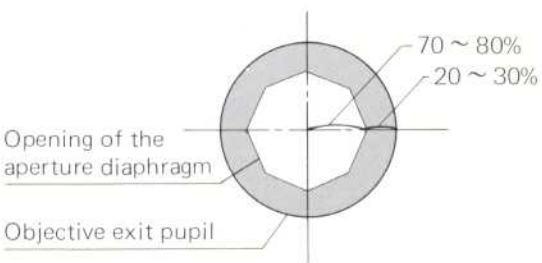


Fig. 16

E. Focus Adjustment

1. Tension of Coarse Adjustment Knobs and Fine Adjustment.

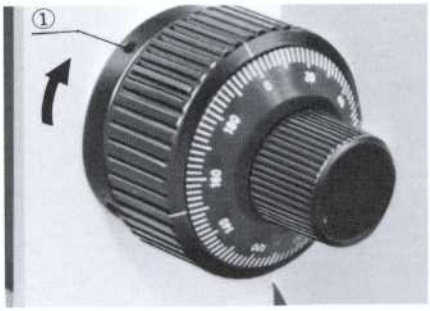
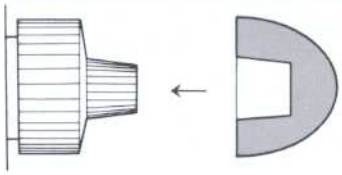


Fig. 17

Although the tension of the coarse adjustment knobs has been already adjusted for optimum performance by the manufacturer, it is possible to personally adjust the tension of the coarse adjustment for either heavy or light movement depending on the operator's preference by rotating the tension adjustment ring ①. (Fig. 17)
The ring can be rotated by inserting a screwdriver into one of the holes on the periphery of the ring. The clockwise rotation (in the direction of the arrow) tightens the coarse adjustment knobs. Do not loosen the ring too much, because the stage may drop or the fine adjustment knobs may slip.

NOTE: Do not rotate the right and left coarse adjustment knobs in the opposite directions simultaneously. If the stage drops and the specimen goes out of focus, the tension adjustment ring is too loose. Tighten the ring.

Use of Rubber Cap for Fine Adjustment Knob



Attaching this cap over the fine adjustment knob increases the sensitivity of the fine focusing motion. **(The rubber cap is optionally available.)**

2. Pre-Focusing Lever

Fig. 18

This lever ② is provided to prevent possible contact between specimen and objective as well as to simplify coarse focusing. (Fig. 18) The lever is locked after coarse focus has been accomplished. This prevents further upward travel of the stage by means of the coarse adjustment knobs, and automatically provides a limiting stop if the stage is lowered and then raised again. The pre-focusing lever does not restrict fine focusing.

3. Adjustment of Stage Block Height

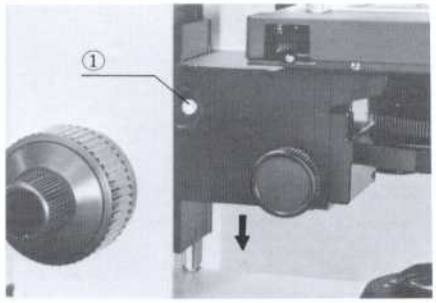


Fig. 19

In addition to the vertical movement of the stage by means of coarse and fine adjustments, the stage block height can be changed for observation of specimens which are thicker than standard slides, e.g. chambers, flasks, etc. with much larger thickness.
The stage block height can be adjusted by loosening the stage block locking screw ① with the Allen wrench provided and retightening it at the upper position. Then, dislocate the lower limit stop pin beneath the stage block into a lower tapped hole. After lowering the stage block, reclamp the stage block locking screw ①. (Fig. 19)

F. Use of Immersion Objectives

1) Focus the specimen with a low power objective.
2) Put a drop of immersion oil on the specimen slide and the front lens of the immersion objective.
3) Turn the revolving nosepiece to bring the immersion objective into the light path, and focus with the fine adjustment knobs.

NOTE: ① For immersion condensers such as an achromatic-aplanatic condenser or Abbe condenser, remove the specimen from the mechanical stage and place a drop of immersion oil on the front lens of the condenser. Then, place the specimen on the stage and slowly raise the condenser until firm contact with the underside of the specimen slide is made.

② Care should be taken to prevent oil bubbles from forming in the oil film between condenser and specimen slide. If any, re-apply immersion oil, for these bubbles greatly deteriorate the lens performance.

③ After use carefully wipe off the immersion oil deposited on the lens surfaces with gauze moistened with xylene. Never leave oil on the lens surfaces after use as oil remnants will seriously impair the performance of the lens system.

G. Photomicrography

The Olympus Photomicrographic Equipment Model PM-10AD is uniquely qualified to be used with the BHT microscope for routine and advanced photomicrography. A separate, detailed instruction manual is available for the PM-10AD camera system.
For quick reference, however, you may want to refer to the following pointers when using the PM-10AD.

1. Photographic Eyepiece
Use NFK photo eyepieces for photomicrography.
Insert the eyepiece into the eyepiece tube of the photo tube. (Fig. 20)

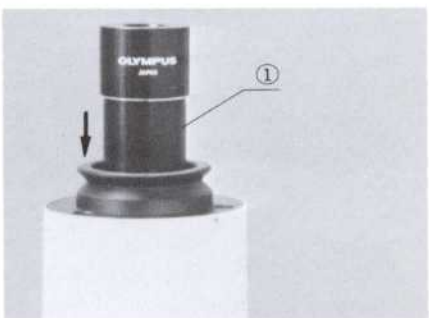


Fig. 20

2. Mounting the Photographic Unit
Slip the body of the photographic unit over the photo tube. Align the dots on photo tube and the PM-10AD body and clamp the camera unit to the photo tube. (Fig. 21)


Fig. 21

3. Setting the Light Path Selector
Refer to section C.3. on page 11.

4. Focusing Procedure

Use the field of view eyepieces for focusing on the film plane. Each field of view eyepiece has a focusing front lens and a reticle with 4 frames, each frame indicating the area covered by a specific power NFK photo eyepeice. (Fig. 22). The number at each frame indicates the magnification of the photo eyepiece. The image in the field of view eyepiece and the image on the film plane are in focus at the same time. Several type field of view eyepieces are available, according to the film size employed.

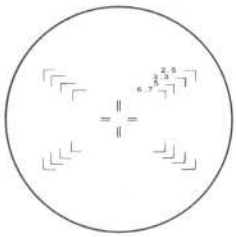


Fig. 22

Field of view eyepiece	35WHK10X	PWHK10X	4X5WHK10X	MHWHK10X
Attachment camera	35mm Back	3¼" x 4¼" Polaroid Back	4" x 5" Sheet Film or Polaroid Film Holder	16mm Bolex camera 120 Roll Film Holder

1) Select the field of view eyepiece matching the camera back in use and insert it into the right eyepiece tube of the trinocular tube, aligning locating groove and locating pin.

2) While looking through the field of view eyepiece, rotate the eyepiece front lens in screw mount to focus on the double cross lines in the field. For sharp focusing with objectives 4X or lower, the focusing magnifier FT is recommended.

3) Bring the specimen detail to be photographed within the frame corresponding to the power of the NFK eyepiece in use and focus on the specimen with the microscope fine adjustment knobs. Make sure the light path selector knob on the observation tube is either on the white (V) or yellow-green (CV) band.

4) It is recommended to tighten the tension adjustment ring considerably to prevent the stage from dropping during long exposures.

VI. OPTICAL DATA

Objective / Eyepiece	Type	D Achromat				D Plan Ach.			
	Magnification	4X	10X	40X	100X*	4X	10X	40X	100X*
	N.A.	0.10	0.25	0.65	1.30	0.10	0.25	0.65	1.25
	W.D. (mm)	18.2	7.2	0.6	0.20	7.03	7.4	0.27	0.17
	Focal length (mm)	30.03	16.9	4.58	1.91	34.23	17.5	4.67	1.75
	Resolving power (μ)	3.36	1.34	0.52	0.26	3.36	1.34	0.52	0.27
WHK10X (Field number 20)	Total mag.	40X	100X	400X	1000X	40X	100X	400X	1000X
	Focal depth (μ)	171.6	27.45	3.0	0.7	171.6	27.45	3.0	0.7
	Field of view (mm)	5	2	0.5	0.2	5	2	0.5	0.2

* Immersion objectives

The resolving power and focal depth are obtained with fully opened aperture diaphragm.

Technical terms:

- Working distance: The distance from the cover glass to the nearest point of the objective.
- Numerical aperture: The N.A. represents a performance number which can be compared to the relative aperture (f-number) of a camera lens. The N.A. values can be used for directly comparing the resolving powers of all types of objectives. The larger the N.A., the higher resolving power.
- Resolving power: The ability of a lens to register small details. The resolving power of a lens is measured by its ability to separate two points.
- Focal depth: The distance between the upper and lower limits of sharpness in the image formed by an optical system. As you stop down the aperture iris diaphragm, the focal depth becomes larger. The larger the N.A. of an objective the shallower the focal depth.
- Field number: A number that represents the diameter in mm of the image of the field diaphragm that is formed by the lens in front of it.
- Field of view diameter: The actual size of the field of view in mm on the object surface.

VII. TROUBLESHOOTING

If you are unable to obtain full performance from your microscope, please consult with the table below as pointers for troubleshooting.

Phenomenon	Cause	Remedy
1. Optical System		
a) With illuminator switched on, the field of view is dark.	Field iris diaphragm is not opened sufficiently.	Open diaphragm to proper diameter.
	Condenser is lowered too much.	Adjust condenser height.
	Light path selector lever is pulled out to C position.	Push in lever up to CV or V position.
b) Field of view is cut off or illuminated irregularly.	Light path selector lever is stopped midway.	Click it into proper position according to your purpose.
	Nosepiece is not clicked into place.	Slightly rotate nosepiece until it clicks into place.
	Nosepiece is not correctly mounted.	Insert nosepiece dovetail into microscope frame all the way, then lock.
	The power of objective used exceeds the illumination capacity of condenser.	Choose a condenser to meet your purpose.
	Condenser is not centered.	Center condenser.
	Field iris diaphragm is stopped down excessively.	Open diaphragm to proper diameter.
c) Dust or dirt is visible in the field of view.	Dust, etc. on light exit lens.	Remove dust, etc. Clean front lenses.
	Dust on condenser top lens.	
	Dirty specimen.	
	Dust on eyepiece.	
d) Excessive image contrast.	Condenser is lowered too much.	Adjust condenser height.
	Aperture iris diaphragm is stopped down excessively.	Open diaphragm to proper diameter.

Phenomenon	Cause	Remedy
e) Resolution problems: • Image is not sharp. • Insufficient contrast. • Image details lack definition.	Non Olympus objectives are used.	Use Olympus LB series objectives.
	Nosepiece is not correctly mounted.	Insert nosepiece dovetail into microscope frame all the way, then lock.
	Objective is not correctly positioned in the light path.	Click nosepiece into place.
	Objective correction collar is not adjusted.	Rotate correction collar, keeping specimen in fine focus until optimum resolution is obtained.
	Dust on objective front lens.	Clean front lens.
	Immersion objective is not used with immersion oil.	Use immersion oil.
	Bubbles in immersion oil.	Remove bubbles (and reapply oil).
	Immersion oil designated by Olympus is not used.	Use Olympus immersion oil.
	Dirty specimens.	Clean.
	Dust on condenser lens.	
f) Field of view is partially out of focus, or image is partly out of focus.	Nosepiece is not correctly mounted.	Insert nosepiece dovetail into microscope frame all the way, then lock.
	Objective is not correctly positioned in the light path.	Slightly rotate nosepiece until it clicks in place.
	Specimen is not correctly positioned on stage.	Place specimen slide correctly on stage, and place stage clips open it.
g) Specimen image is partially out of focus.	Nosepiece is not correctly mounted.	Insert nosepiece dovetail into microscope frame all the way, then lock.
	Objective is not correctly positioned in the light path.	Slightly rotate nosepiece until it clicks into place.
	Condenser is not centered.	Center condenser.
h) Field of view becomes only slightly brighter by increasing voltage.	Condenser is not correctly centered.	Center condenser.
	Condenser is lowered too much.	Adjust condenser height.
2. Electric System		
a) Illuminator is too bright (or too dark) even when adjusting control lever.	Line voltage selector switch is not matched with local mains voltage.	Match selector switch to mains voltage.
b) Voltage for illuminator cannot be raised.		

Phenomenon	Cause	Remedy
c) Lamp goes off and on.	Bulb filament is likely to burn out.	Replace bulb.
	Loose electric connections.	Check all connections.
d) Bulb burns out frequently.	Line voltage selector switch is not matched with local mains voltage.	Match selector switch to mains voltage.
	Bulb is not standard one.	Use standard bulb.
3. Coarse and Fine Adjustments		
a) Coarse adjustment knob is too tight.	Tension adjustment ring is tightened too much.	Loosen ring properly.
	User is trying to raise stage above the focusing limit imposed by the engaged pre-focusing lever.	Unlock lever.
b) Stage drops or specimen goes out of focus during observation due to slipping fine adjustment knobs.	Tension adjustment ring is too loose.	Tighten ring properly.
c) Stage cannot be raised to the upper limit.	Pre-focusing lever is engaged in lower than focusing position.	Unlock lever.
d) Stage cannot be lowered to the lower limit.	Stage is mounted too low.	Raise stage mount with Allen wrench.
e) Objective front lens hits specimen before coming into focus.	Specimen is placed on stage upside down.	Reverse specimen.
4. Observation Tubes		
a) Incomplete binocular vision.	Interpupillary distance is not correctly adjusted.	Correct the interpupillary distance.
	Diopter adjustment is incomplete.	Complete the diopter adjustment.
	Right and left eyepieces are not matched.	Use a pair of matched eyepieces.
	User is unaccustomed to binocular vision.	Prior to looking into the binocular observation tube, look at a far away object.
5. Stage		
a) Image easily goes out of focus when you touch the stage.	Stage is not correctly locked.	Clamp stage securely.
b) Specimen stops midway on the east-west traverse.	Specimen is not correctly positioned.	Adjust specimen position.

PHASE CONTRAST ATTACHMENT

MODEL BH2-PC

This instruction manual has been prepared for the use of the Phase Contrast Attachment Model BH2-PC. This attachment is specially designed for use in conjuction with the LB Series optical units, pertaining to objectives, eyepieces, photo eyepieces and intermediate adapters. Therefore, it is recommended that you read the instruction manual provided with the Olympus BH2 Series microscope in use first, and then follow the steps mentioned in this manual so that you can obtain optimum performance from it.

I. STANDARD EQUIPMENT

Component			BH2-PC-							
			PA		PB					
			1	2	1	2	3	4	5	6
Phase contrast turret condenser BH2-PC			1	1	1	1	1	1	1	1
Centering telescope CT-5			1	1	1	1	1	1	1	1
Objectives	PC-S Plan	10X-PL 20X-PL 40X-PL 100X-PL (oil) (Set of 4)	1		1					
	PC-S Plan	10X-NH 20X-NH 40X-NH 100X-NH (oil) (Set of 4)	1			1				
	PC-D Ach.	10X-PL 20X-PL 40X-PL 100X-PL (Set of 4)		1			1			
	PC-D Ach.	10X-PLL 20X-PLL 40X-PLL 100X-PLL (oil) (Set of 4)		1				1		
	PC-D Ach.	10X-NH 20X-NH 40X-NH 100X-NH (oil) (Set of 4)		1					1	
	PC-D Ach.	10X-NM 20X-NM 40X-NM 100X-NM (oil) (Set of 4)		1						1
Auxiliary clamping wrench			1	1	1	1	1	1	1	1
Interference filter 43IF550-W45			1	1	1	1	1	1	1	1

II. NOMENCLATURE

Phase Contrast Turret Condenser BH2-PC

Mounting collar

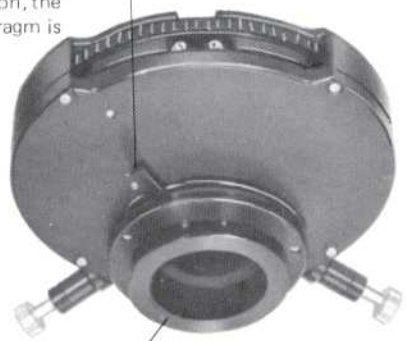
Can be inserted into the condenser mount (36.8 mm diameter) of a microscope.

Light annulus centering knob

Phase contrast turret

Aperture iris diaphragm lever

As the turret is set to the light annulus position, the aperture iris diaphragm is fully opened.



Centering telescope CT-5

Interference filter 43IF550-W45

Auxiliary clamping wrench

Mounting dovetail

Can be attached to the condenser mount of a BH2 Series microscope.

(When the phase contrast condenser is attached to the condenser mount of 36.8mm diameter, push the auxiliary clamping wrench over the condenser clamping screw and tighten the condenser clamping screw. After tightening, remove the wrench.)

III. USE OF THE PHASE CONTRAST TURRET CONDENSER

■ Summary of Observation Procedure

1. Attach the phase contrast turret condenser to the microscope condenser mount.
2. Mount the phase contrast objectives on the revolving nosepiece.
3. Center the phase contrast condenser.
4. Swing the objective of your choice into the light path, and rotate the condenser turret to match the light annulus magnification with the objective magnification in use.
5. Place a specimen on the stage and focus.
6. Center the light annulus of each magnification.
7. Observe the phase contrast image.

1. Mount the Phase Contrast Objectives on the Nosepiece

Select the phase contrast objectives according to your requirements.
Olympus phase contrast objectives are available in the following contrasts:

N: Negative P: Positive H: Hight M: Medium
L: Low LL: Low-low

Letter	Contrast	Application
P	Positive	Observation of the internal structure of cells or nuclei.
N	Negative	Observation of minute objects, such as spores, flagella and live specimens.
H	High	When the specimen contrast is relatively low.
L	Low	When the specimen contrast is relatively high.

2. Center the Phase Contrast Condenser

(This step is omitted if the condenser is not provided with any centering device.)

1) Rotate the phase contrast turret until the letter "0" can be seen through the central window, and open the aperture iris diaphragm fully.
2) Place a specimen on the stage, bring the 10X objective into the light path and focus on the specimen.

★ **If an auxiliary lens system or high/low magnification selector is provided with the microscope used, set it to position for the 10X objective.**

3) Stop down the field iris diaphragm of the microscope.
4) While looking through the eyepieces, move the condenser up and down with the condenser height adjustment to focus on the image of the field iris diaphragm.
5) Widening the diameter of the field iris diaphragm progressively, manipulate the condenser centering knobs to bring the diaphragm image into the center of the field of view. (Fig. 1) When the polygonal image of the iris diaphragm becomes inscribed in the field, slightly increase the diameter of the field iris diaphragm until it is just outside the field of view.

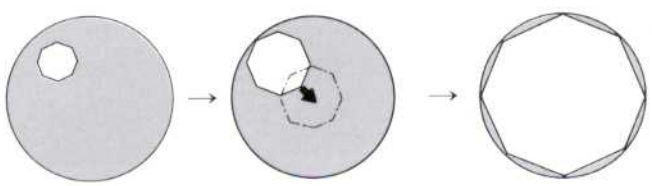


Fig. 1

3. Align the Phase Annulus and Light Annulus.

1) Swing the objective of your choice into the light path.
2) Rotate the phase contrast turret until the number corresponding to the objective magnification is seen through the central window.
3) Focus on the specimen.

★ **In case the microscope is provided with the auxiliary lens system or high/low magnification selector lever, set it to position for the objective magnification used.**

4) Remove one of the eyepieces, and insert the centering telescope CT-5 into the eyepiece tube.
5) Rotate the top lens assembly of the CT-5 to bring the bright ring (light annulus in the condenser) and the dark ring (phase annulus in the objective) in forcus.
6) Rotate the two light annulus centering knobs ① of the condenser until light annulus and phase annulus are concentric and superimposed. (Fig. 2)

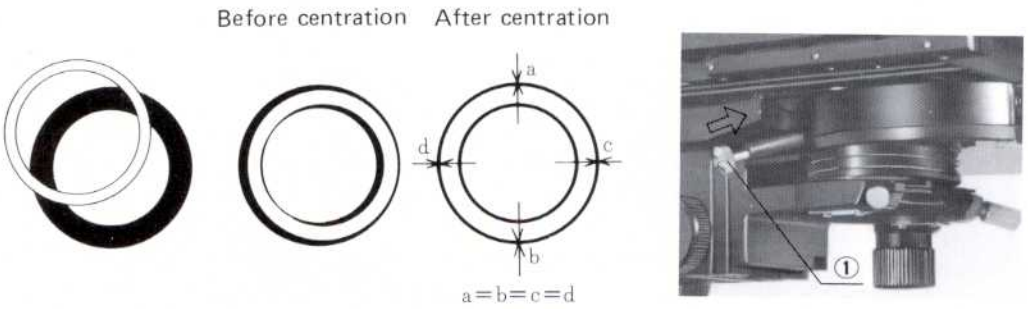


Fig. 2

★ **The other objectives should be centered respectively in the same manner.**

7) Remove the CT-5, and insert the eyepiece back into the eyepiece tube.
Now you can start your phase contrast microscopy with any phase contrast objective and corresponding light annulus as desired.

4. Use of the Interference Filter

The interference filter 43IF550-W45 is provided for observation with tungsten light and monochromatic phase contrast photography. The filter is inserted into the filter mount on the microscope base.

★ **For use in conjunction with the swing-out filter mount BH-FH, optionally available, place the interference filter on the top of the filter mount.**

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