

BINOCULAR TUBE
CH3-BI45
REPAIR MANUAL

OLYMPUS

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1. Outline

CH3-BI45 is a Siedentopf type binocular tube with inclined at a viewing angle of 45° (fixed), and combined with the system microscope CH30 or CH40 for education and laboratory, etc.

2. Features

- (1) One-side helicoid ring enables the left/right diopter difference compensation.
- (2) The siedentopf type observation tube prevents the optical path length from varying with the interpupillary distance, and enhances the dustproof and fungusproof performance.
- (3) It is possible to observe in wide range of field number 20. (Conventional field number was 18.)
- (4) The interpupillary distance is adjustable from 48 mm to 75 mm, applicable to various observer's eyes. (Conventional range was 53 mm to 72 mm.)
- (5) The eyepiece is antitheft as it can be fixed with the clamping screw.

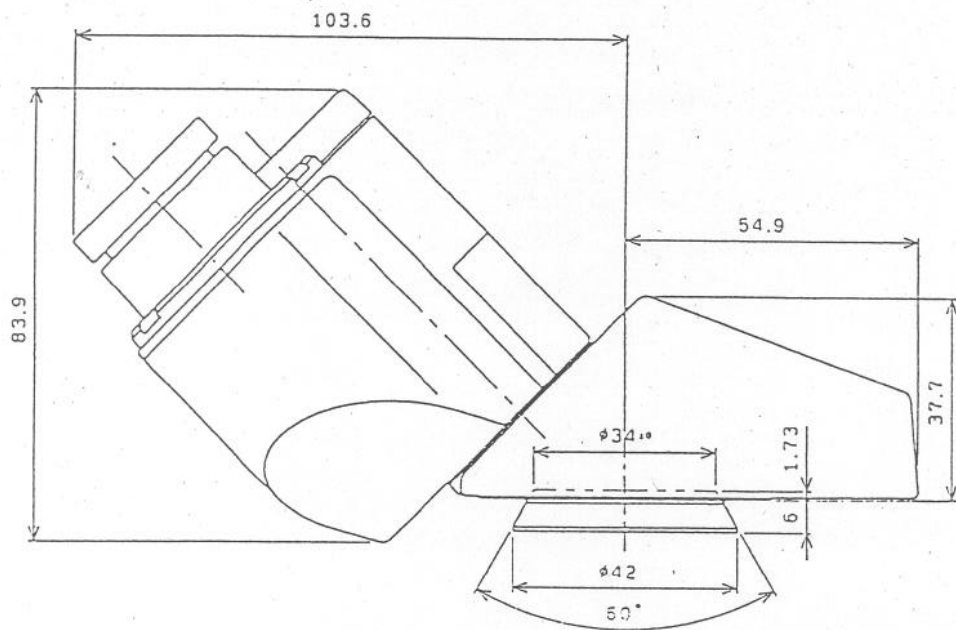
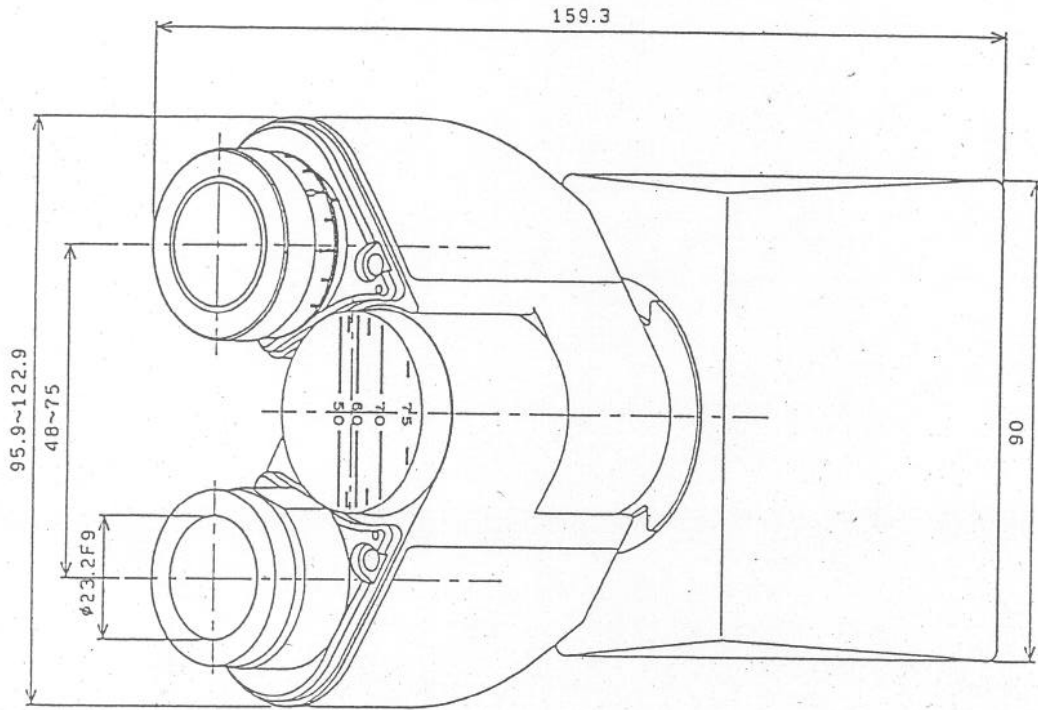
3. Using Conditions

- (1) Applicable frame: CH30-F, CH40-F
- (2) Applicable eyepiece: WHK10X, CWHK10X
- (3) Applicable objective: EDAch, DAch series
- (4) Using environment: Temperature 0 to 40°C
Humidity 30 to 90 %
- (5) Others: Fixable at an arbitrary position in an angle of 360°
(horizontal direction) only when the interpupillary distance is at the maximum.

4. Specifications

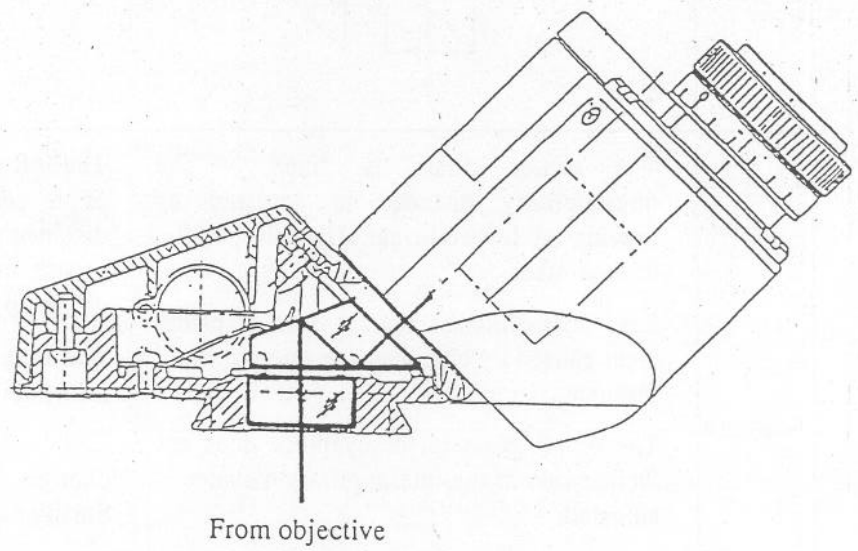
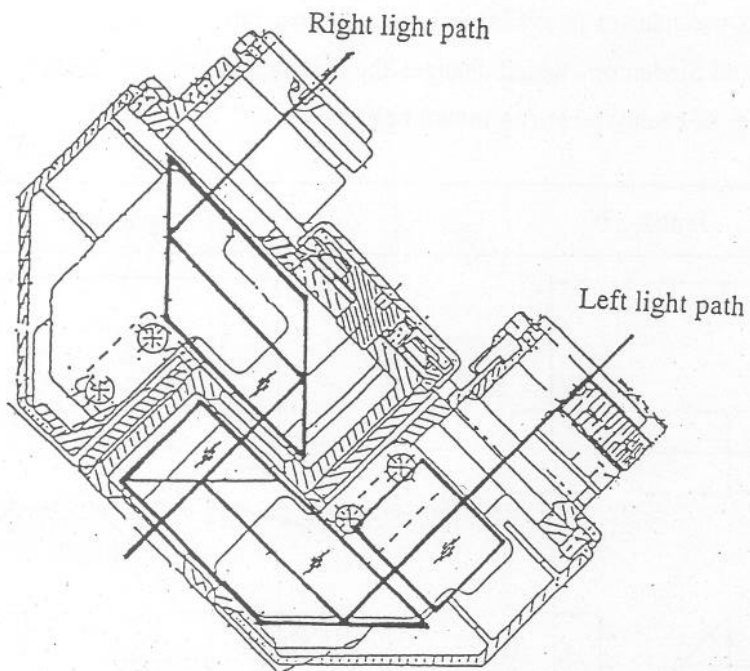
Item		Specifications	Remarks
1	Type	Siedentopf	
2	Field number	20 (when using WHK10X) 18 (when using CWHK10X) (Eyepiece sleeve diameter ϕ 23.2 mm)	
3	Inclination	45° fixed	
4	Interpupillary distance adjustment range	48 to 75 mm	
5	Magnification	1×	
6	Image direction	Inverted image	
7	Left/right diopter difference compensation	Helicoid ring for adjustment provided in the left sleeve (Diopter range: \pm 5 diopters)	
8	Mounting on the frame	Circular dovetail (ϕ 34 mm, depth 6 mm)	
9	Eyepoint height	93.4 mm (when using CWHK10X) (Arm mounting surface to eyepoint)	At standard interpupillary distance (62 mm)
10	Weight	Approx. 0.5 kg	
11	Dimensions	See the next page.	

5. Dimensions



Unit: mm

1. Light Path Diagram



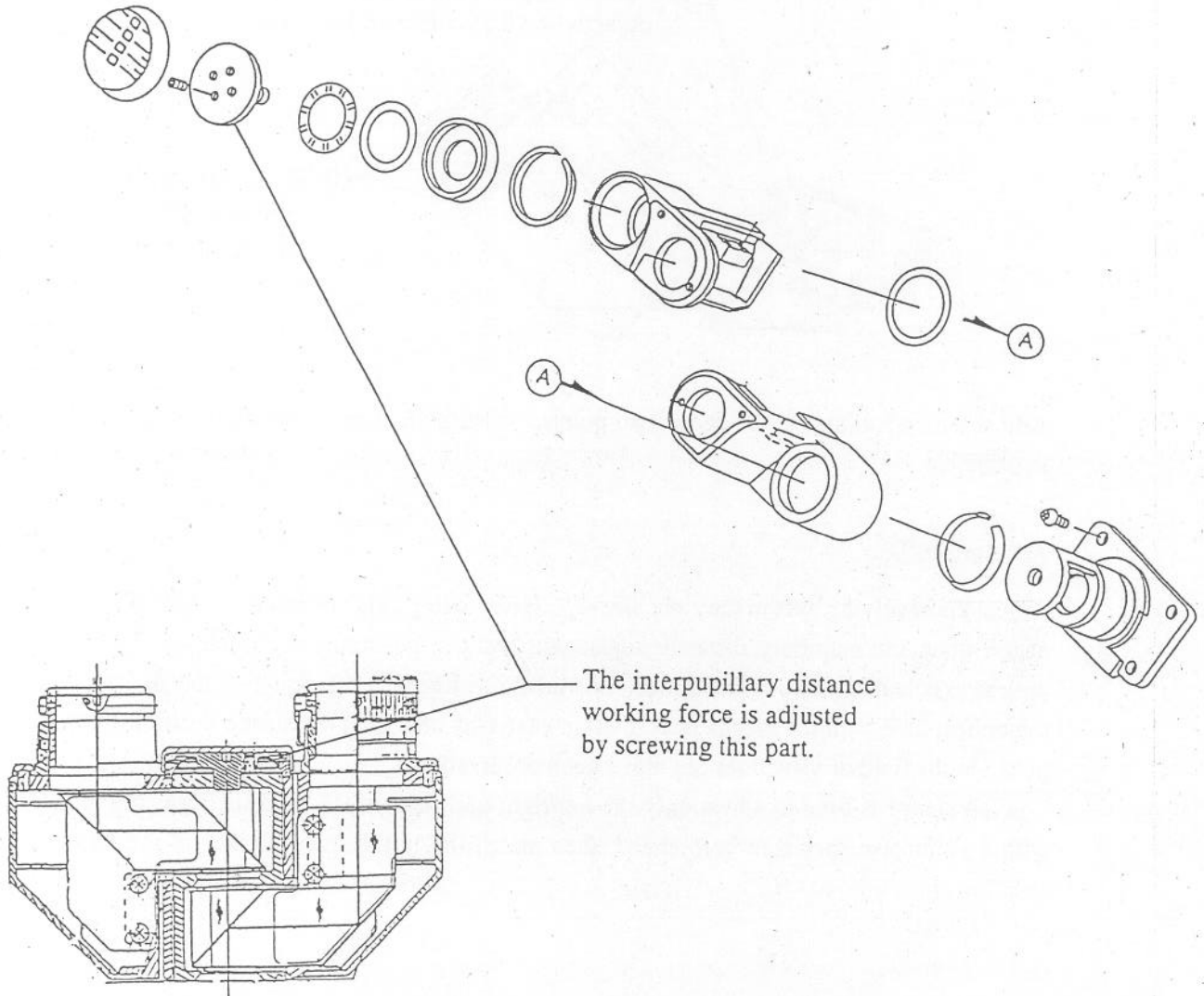
2. Jentsh and Siedentopf

Binocular tube has the mechanism to adjust the distance between left and right optical axes to meet the observer's eyes. This mechanism is available in two typical types: Jentsh which changes the distance in a straight line and Siedentopf which changes the distance in an arc. Each type has merits and demerits. The features of each type are as shown below.

	Jentsh	Siedentopf
Light path diagram		
Features	<ul style="list-style-type: none"> • The center prism is fixed. The interpupillary distance is adjusted by moving the left and right prisms in parallel to each other. • Less possibility of optical axis displacement caused by changing the interpupillary distance. • The reticle glass in the eyepiece does not incline even if the interpupillary distance is adjusted. • The tube length changes as a result of the change in the optical path length when the interpupillary distance is adjusted. • Compact design. 	<ul style="list-style-type: none"> • The left and right prisms have the function of a center prism. The interpupillary distance is adjusted by moving these prisms in an arc centering the optical axis going up from the objective. • The tube length is not changed even if the interpupillary distance is adjusted. • The interpupillary distance does not change even if the eyepiece is pushed during observation. • The reticle glass in the eyepiece inclines when the interpupillary distance is adjusted.

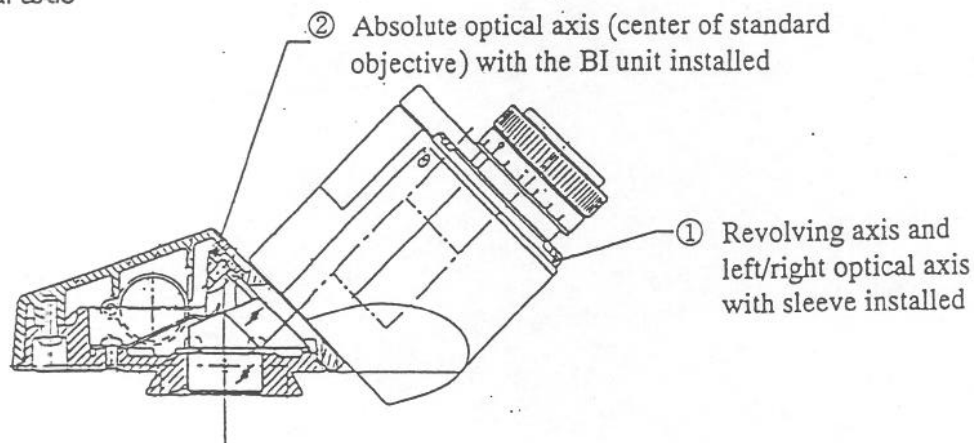
3. Interpupillary Distance Adjustment Mechanism

3-1 Working force



4. Optical Adjustment Mechanism

4-1 Optical axis



Adjust the optical axis at the above two points. The internal prism position is adjustment-free in principle.

Adjustment ①:

Adjust the revolving axis in the right sleeve. ("Revolving axis" means the mechanical rotation center upon interpupillary distance adjustment and the phenomenon which occurs when the optical axis is displaced. The optical axis mentioned here is the center of the sleeve. Align the optical axis with the mechanical rotation center by changing the sleeve position so that the image in the field of view does not move upon observation.)

The left sleeve is used to adjust only the left/right optical axis. (Align the right sleeve center with a point of a specimen beforehand, then match the left sleeve center with the point of a specimen.)

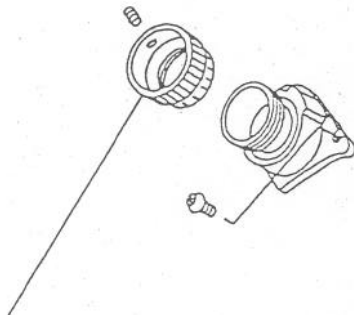
Adjustment ②:

Almost the same as the adjustment method performed for installation of the BI unit of the U-BI30.

Mount the standard objective on the revolving nosepiece of adjusted frame. Mount the BI unit with the standard eyepiece inserted into the right sleeve on the frame. Change the BI unit mounting position so that the cross center of a specimen in the standard objective coincides with the cross hairs center of the standard eyepiece.

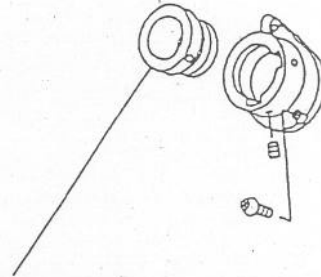
4-2 Tube length

Left sleeve



Adjust "0" position of helicoid scale to the index.

Right sleeve



The tube length can be changed by adjusting this sleeve-R vertically.

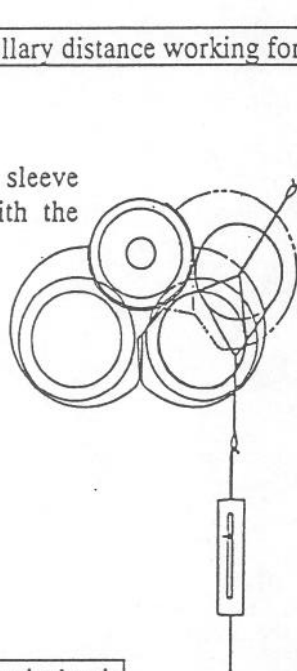
1. Check Items and Methods

Item		Standard	Method
Interpupillary distance adjustment	Adjustment range	48 mm or less at min. ~ 75 mm or more at max.	Set the observation state, insert a thin paper with graduations at the eye point position and measure the interpupillary distance.
	Working force	500 to 1200 g	Tie a string around the sleeve periphery and measure the interpupillary distance working force with a tension gauge.
Diopter difference compensation	Adjustment range	± 5 diopters min.	Turn the scale ring and check that the scale goes over the limit.
Optical axis	Left/right optical axis difference	On the image surface: Max. 0.2 mm in the vertical direction Max. 0.2 mm in the outward direction Max. 0.4 mm in the inward direction	Set the observation state, use the standard eyepiece KN0048 and observe a specimen whose center can be identified (e.g., an concentric circle). Align the centers of the specimen and the visual field taking the right sleeve as a standard, then check the centers displacement in the left sleeve by reading the reticle scale (1 graduation = 0.1 mm) of KN0048.
	Absolute optical axis (right sleeve only)	0.25 mm or less on the image surface when the interpupillary distance is 62 mm	Set the interpupillary distance to about 62 mm, combine the standard eyepiece (KN0048), the microscope frame (product), and the standard objective (KN0015). Then check the displacement between the centers of the specimen and the visual field in the right sleeve by reading the reticle scale (1 graduation = 0.1 mm) of KN0048.
	Exit pupil center	Within 20 % of the objective's exit pupil diameter	Set the interpupillary distance to about 62 mm, combine the centering telescope (KN0029) plus the KN0048 accessory adapter-2, the microscope frame (product), and the objective (4 \times or 10 \times). Then check the displacement between the center of the objective's exit pupil diameter and the cross hairs center of the centering telescope.
Tube length	Parfocality	± 0.25 mm	Set the interpupillary distance to about 62 mm (refer to the above item for the interpupillary distance adjustment), combine the standard eyepiece (KN0048 + FT-36), the microscope frame (product), and the standard objective (KN0016). Then check the parfocality displacement in the left and right sleeves by reading the helicoid scale of KN0048.
	Difference between left and right tube length	less than 1 mm	Set the scale ring at "0". Put a rigid flat plate across the left and right sleeve end face, insert a 1 mm thickness gauge between the flat plate and the tube surface. If the clearance is greater than 1 mm, the

2. Use of Jigs and Tools

Measuring the interpupillary distance working force

Tie a string around the sleeve periphery and pull with the tension gauge.



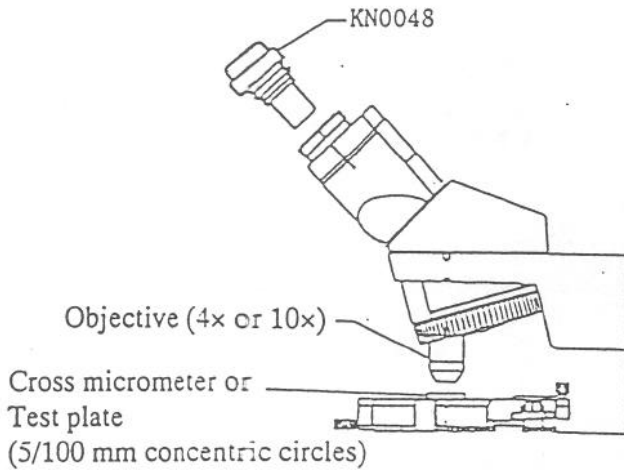
Tension gauge

Pull in the close state.

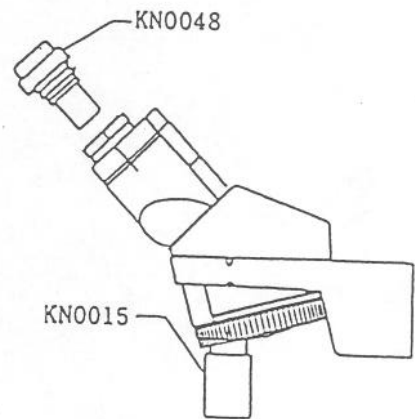
(Note) When using the tension gauge to measure in the open state, add about 100g to the measurement value (in the case of a 3 kg tension gauge).

Pull in the open state.

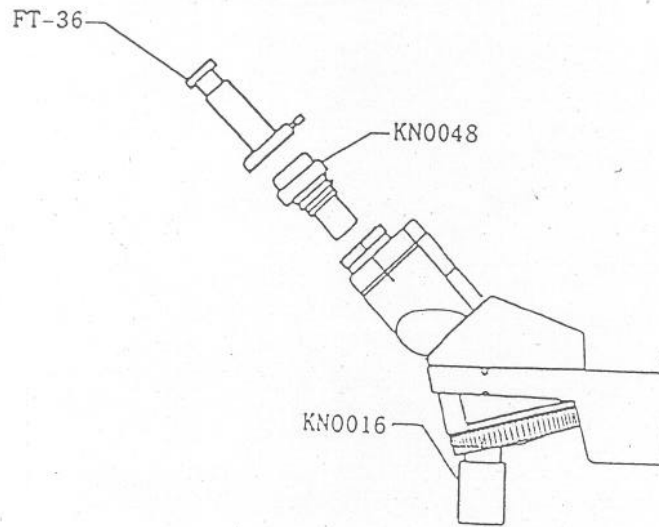
Checking the left/right optical axis



Checking the absolute optical axis

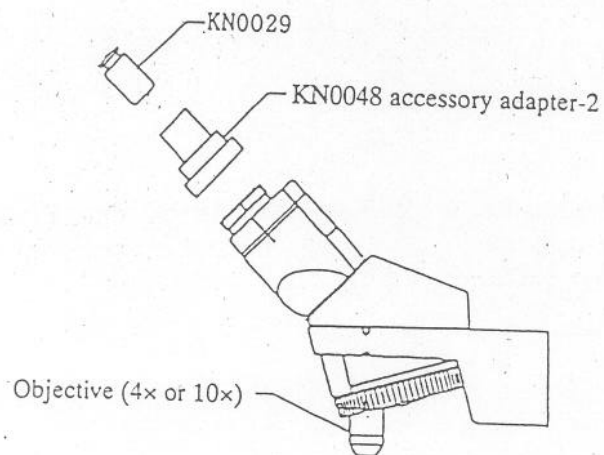


Checking the tube length

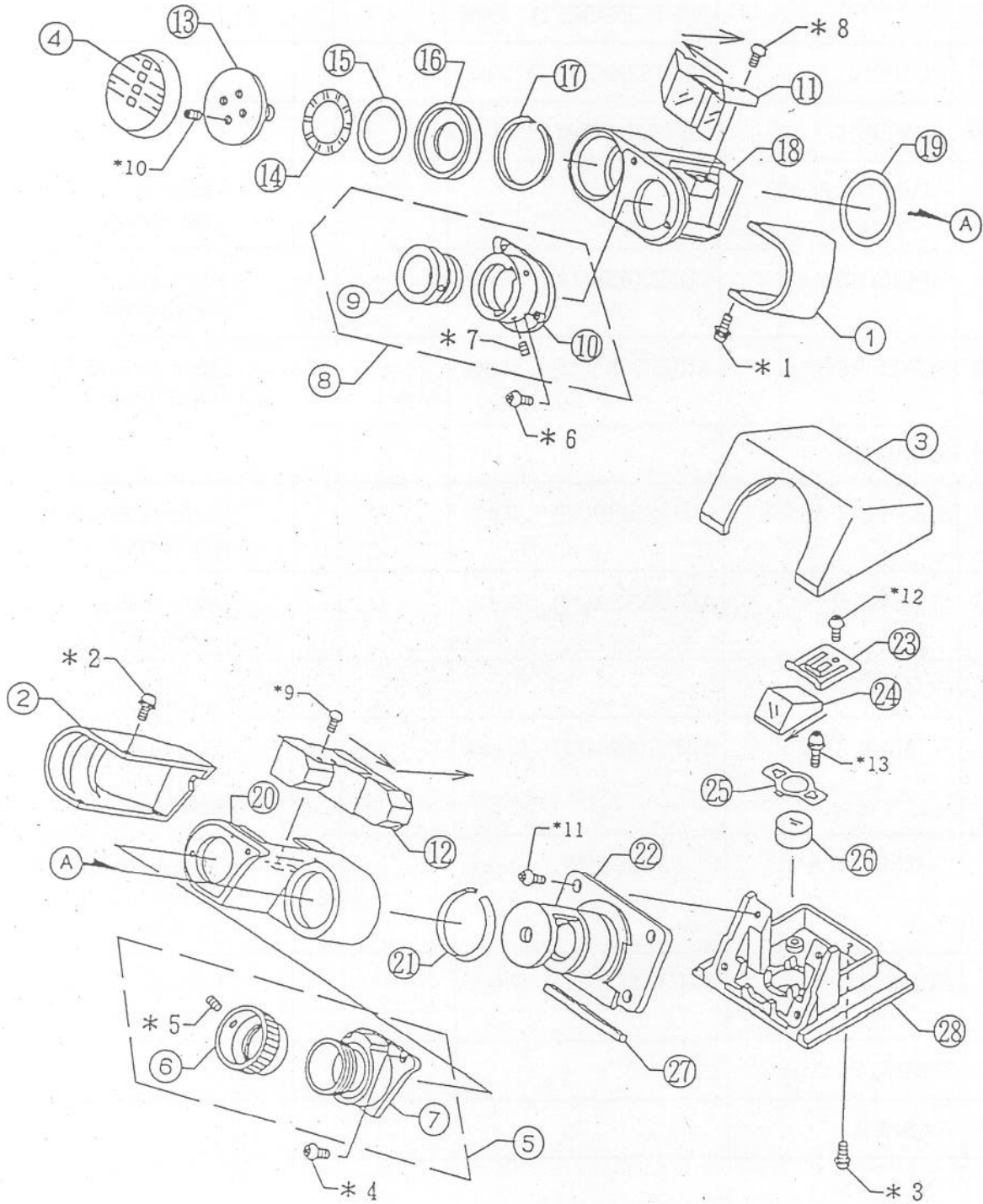


Checking the exit pupil center

※ Use the KN0048 accessory adapter-2 upside down.



1. Entire Disassembly and Assembly



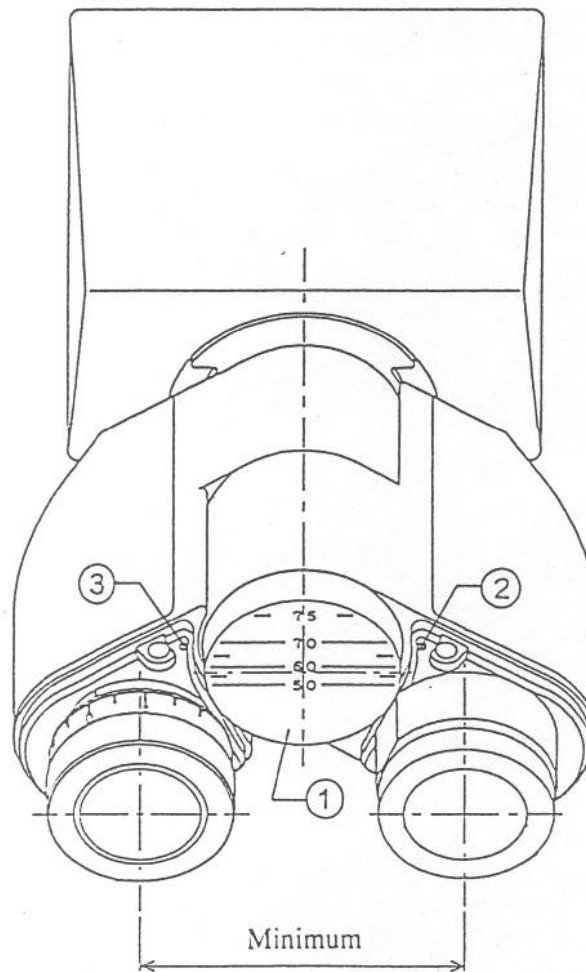
No.	Parts name	Screw	Grease	Adhesive	Remarks
①	COVER-R	3PUTS2X4SB(*1) 3 pcs.			
②	COVER-L	3PUTS2X4SB(*2) 3 pcs.			
③	COVER-H	CUTB3X10SA(*3) 1 pc.			
④	DIVISION PLATE				Refer to D-4 for the assembly procedure.
⑤	HELICOID ASS'Y	CUK3X6SB(*4) 2 pcs.			Refer to E-8 for the repair procedure.
⑥	SCALE RING	ACU3X3SA(*5) 2 pcs.			Refer to E-15 for the repair procedure.
⑦	HELICOID				
⑧	SLEEVE-R ASS'Y	CUK3X6SB(*6) 2 pcs.			Refer to E-5 for the repair procedure.
⑨	SLEEVE- R	ACU3X3SA(*7) 2 pcs.			Refer to E-14 for the repair procedure.
⑩	OC MOUNT-R				
⑪	PRISM-R ASS'Y	CUK3X6SA(*8) 2 pcs.			To be pushed all the way in the arrow direction
⑫	PRISM-L ASS'Y	CUK3X6SA(*9) 2 pcs.			To be pushed all the way in the arrow direction
⑬	ADJ. SCREW	ACU3X5SA(*10) 2 pcs.			Refer to E-17 for the repair procedure.
⑭	SPRING WASHER				
⑮	WASHER				
⑯	FIXING RING				
⑰	C-RING		OT1595		
⑱	PRISM MOUNT-R				
⑲	WASHER		OT1595		

No.	Parts name	Screw	Grease	Adhesive	Remarks
⑳	PRISM MOUNT-L				
㉑	C-RING		OT1595		
㉒	SHAFT	CUK3X6SA(*11) 4 pcs.			Refer to E-10 for the repair procedure.
㉓	FIXING PLATE	CUTS3X6SA(*12) 1 pc.			
㉔	PRISM			OT1873	To be pushed all the way in the arrow direction. Refer to E-12 for the repair procedure.
㉕	DIAPHRAGM	3PUTS2X4SB(*13)2 pcs.			
㉖	PRISM				
㉗	DUST PROTECTOR				
㉘	BODY				

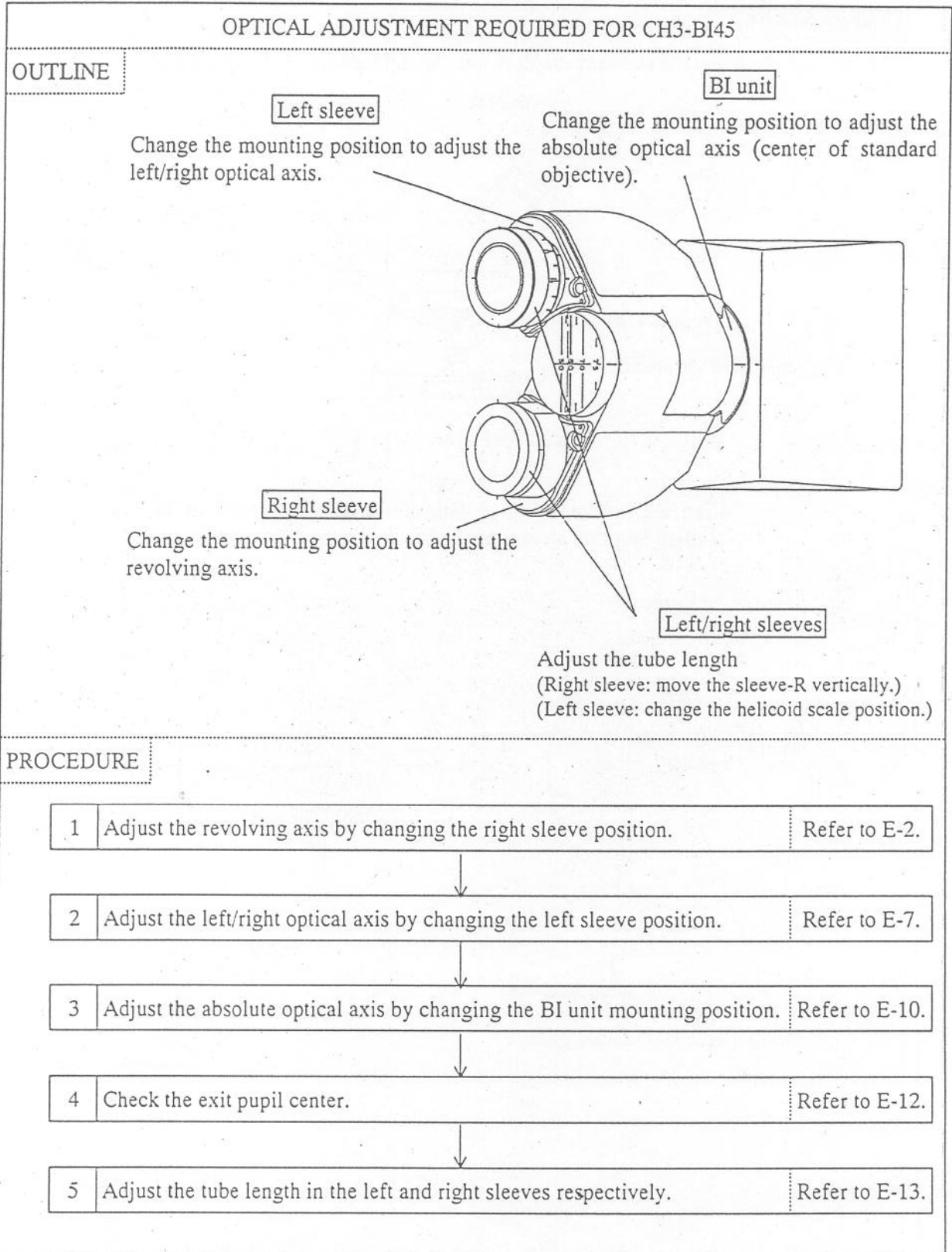
2. Division Plate Assembly Procedure

2-1 Stick the DIVISION PLATE ① in the following procedure.

- (1) Minimize the interpupillary distance.
- (2) Stick the DIVISION PLATE ① so that the ROUND PROJECTION ② of the sleeve-R assembly and the ROUND PROJECTION ③ of the helicoid ring assembly read the same graduation of the division plate.



1. Optical Adjustment Procedure

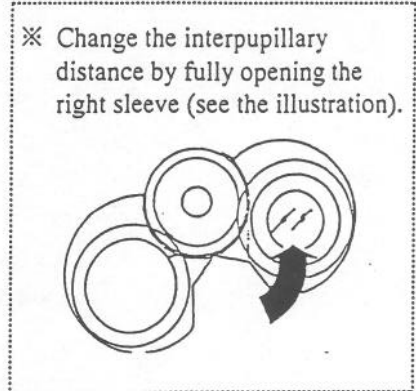
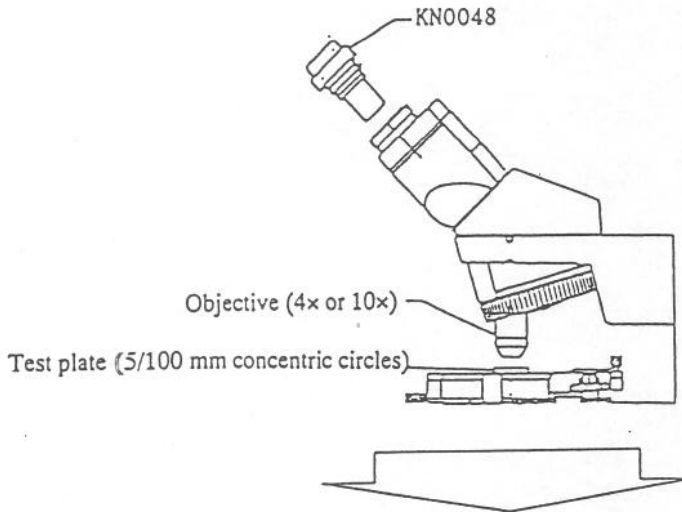


1-1 Adjusting the revolving axis

PREPARATION

※ Insert the standard eyepiece into the right sleeve.

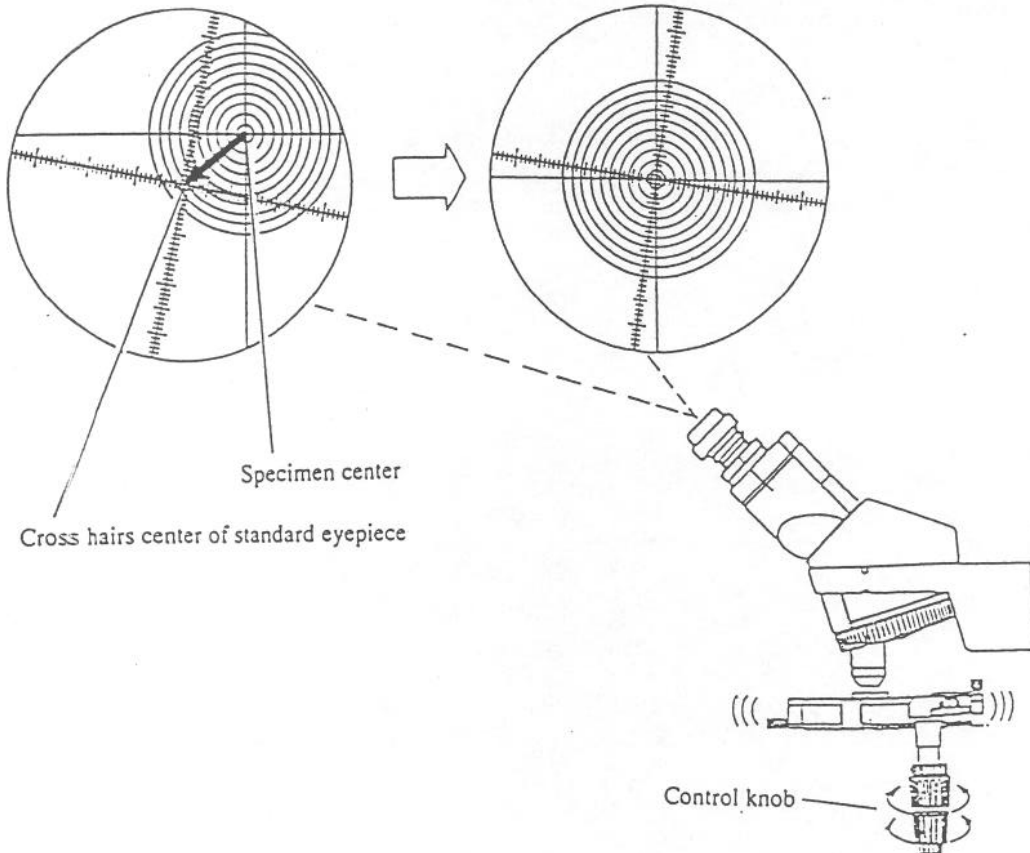
※ Change the interpupillary distance by fully opening the right sleeve (see the illustration).



Align the specimen center with the cross hairs center of the standard eyepiece by turning the control knob of the stage.

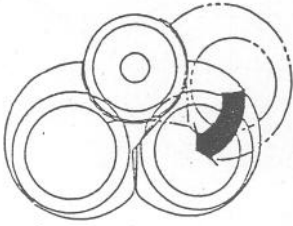
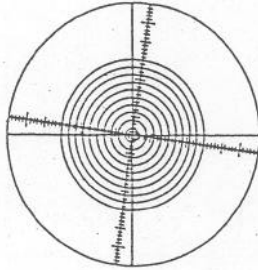
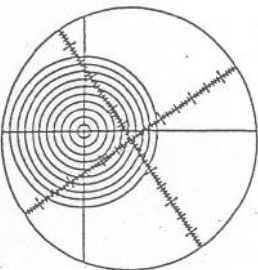
Before adjustment

After adjustment



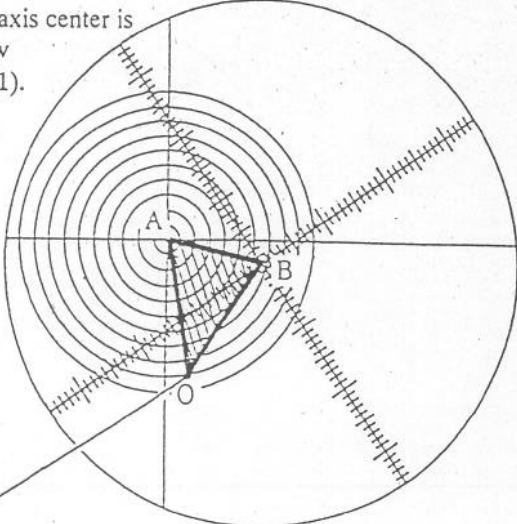
SEARCHING FOR THE REVOLVING AXIS CENTER

(1) Checking the optical axis displacement by the revolving axis.

Work	Image seen through the standard eyepiece	
<p>Gradually reduce the interpupillary distance while observing through the standard eyepiece.</p> 	<p>The centers are aligned at first.</p> 	<p>The centers are displaced as shown below.</p> 

(2) Searching for the revolving axis center from the optical axis displacement amount and direction checked in (1) above.

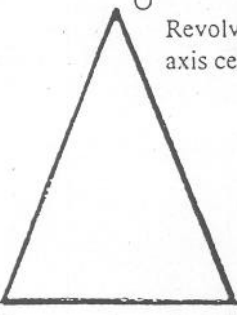
The revolving axis center is as shown below in the case of (1).



Revolving axis center

When the interpupillary distance is reduced, the concentric circles center moves from B to A.
 The revolving axis center "O" is located on the left-hand side of the moving direction. (When the interpupillary distance is increased, the revolving axis center "O" is located on the right-hand side of the moving direction.)

The triangle formed by A, B and O is always constant in shape.
 → Revolving axis triangle
 The revolving axis center can be found simply by adopting this triangle.



Revolving axis triangle

Revolving axis center

Cross hairs center B of standard eyepiece

A Specimen center

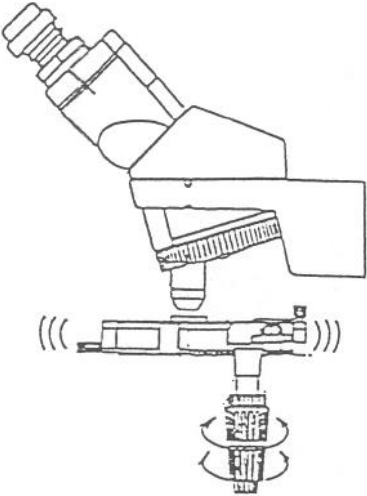
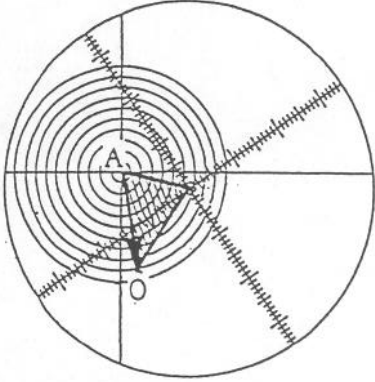
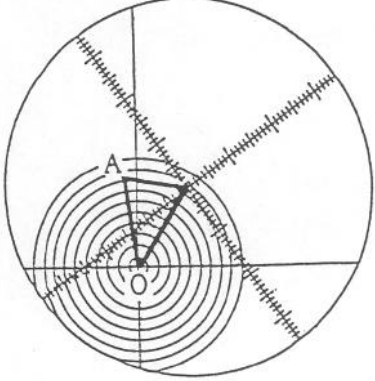
Reference

$OAB \cong 68^\circ$

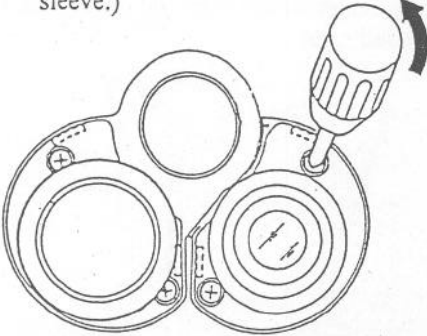
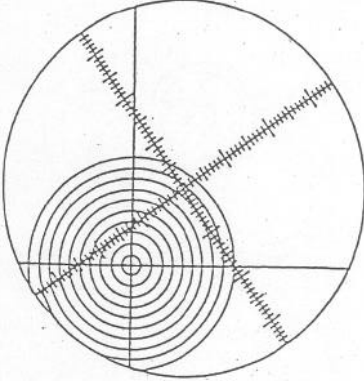
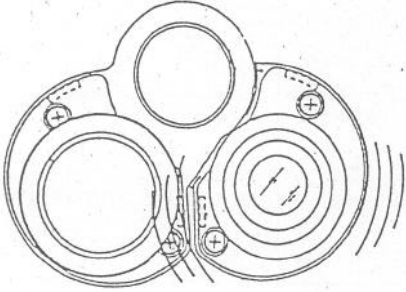
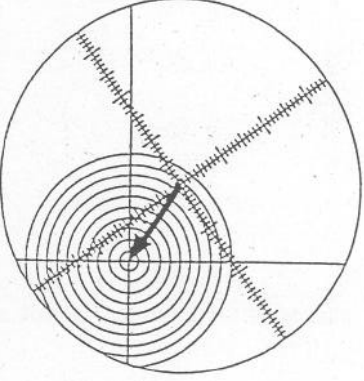
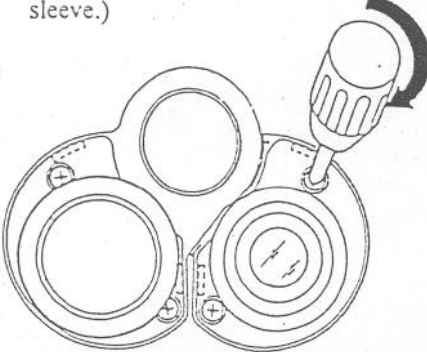
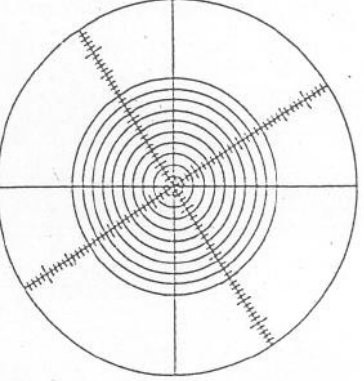
$AB : AO \cong 1 : 1.3$

(cont.)

(3) Aligning the specimen center with the revolving axis center found in (2) above.

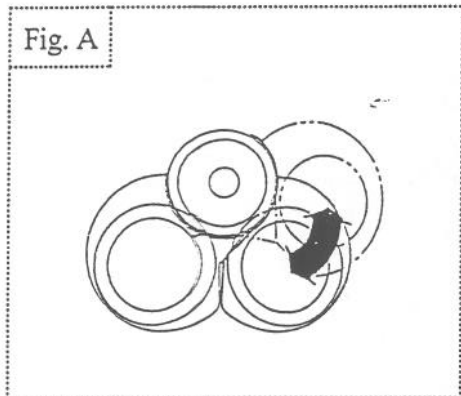
Work	Image seen through the standard eyepiece
<p data-bbox="200 495 796 562">Move the specimen center from A to O by turning the stage control knob.</p> 	<p data-bbox="827 495 989 528">Image at first</p>  <p data-bbox="827 1055 1193 1088">Image at the end of adjustment</p> 

ALIGNING THE CROSS HAIRS CENTER OF THE STANDARD EYEPIECE (the right sleeve optical axis) WITH THE SPECIMEN CENTER (the revolving axis center).

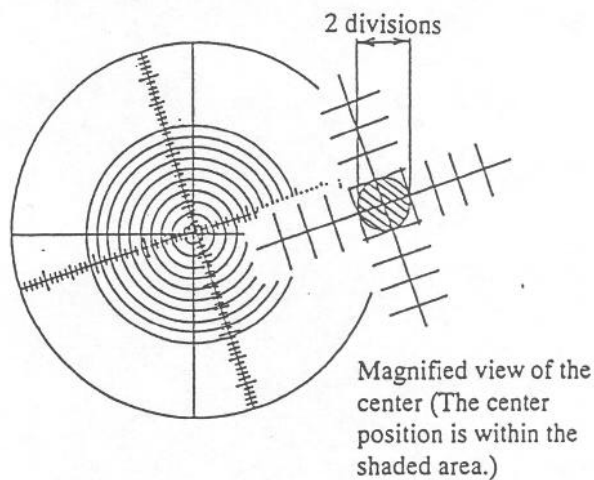
Work	Image seen through the standard eyepiece
<p>(1) Loosen the two screws slightly which secure the right sleeve. (Use a thin screwdriver. A thick screwdriver may damage the outside surface of sleeve.)</p> 	<p>Image at first</p> 
<p>(2) Align the cross hairs center of the standard eyepiece with the specimen center while observing through the standard eyepiece. (Change the right sleeve position by hand.)</p> 	<p>The centers are aligned.</p> 
<p>(3) Firmly tighten the screws which secure the right sleeve. (Use a thin screwdriver. A thick screwdriver may damage the outside surface of sleeve.)</p> 	<p>Image at the end of adjustment</p> 

CHECKING THE REVOLVING AXIS

Change the interpupillary distance as shown in Fig. A and check if the specimen center in the right sleeve is seen within the range shown in Fig. B.

Fig. A**Fig. B**

The specimen center in the right sleeve should be seen within the shaded area.



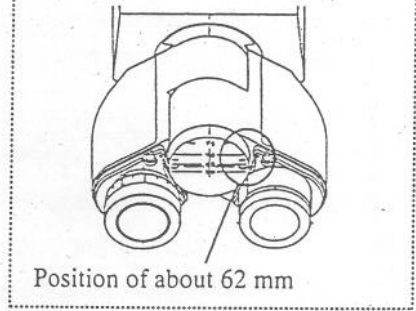
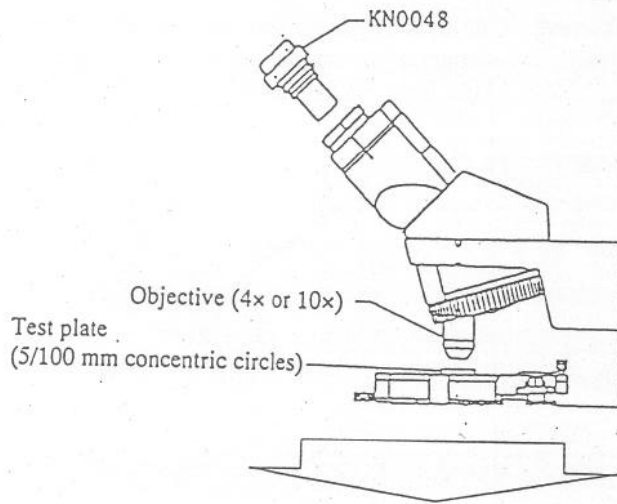
If the specimen center is not seen within the standard area, return to E-2 and repeat the adjustment.

1-2 Adjusting the left/right optical axis

PREPARATION

※ Insert the standard eyepiece into the right sleeve.

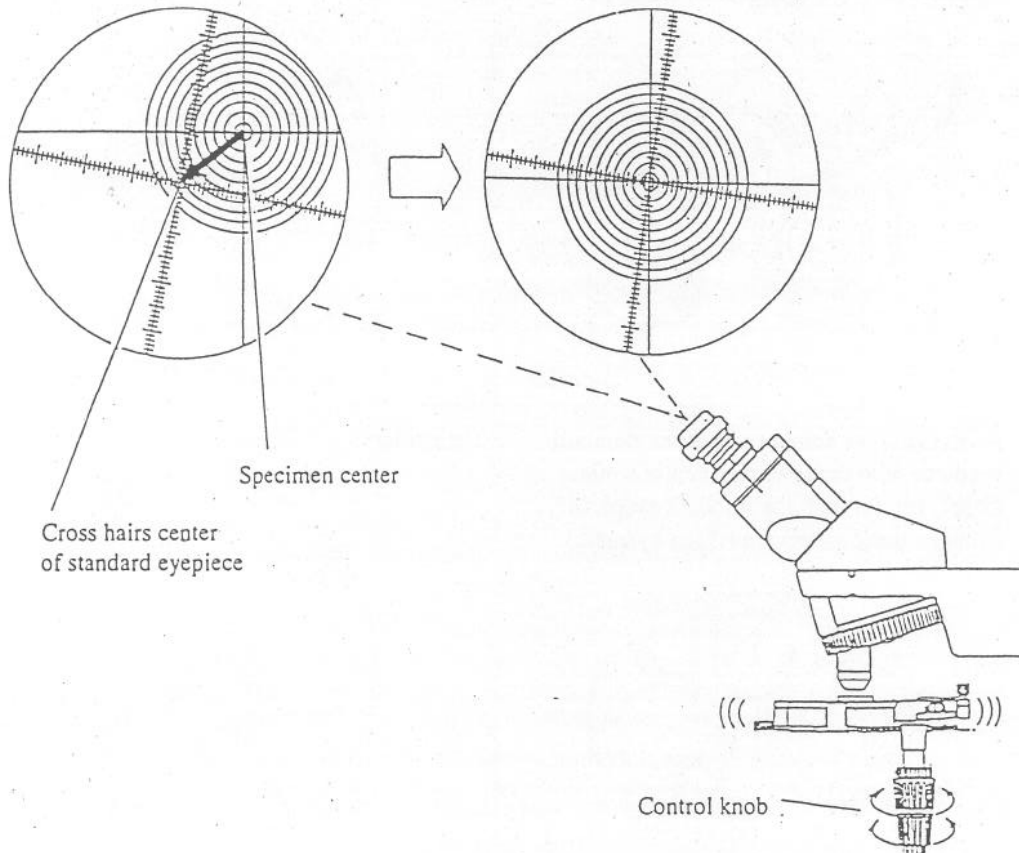
※ Set the interpupillary distance to about 62 mm.
(See the illustration.)



Align the specimen center with the cross hairs center of the standard eyepiece by turning the control knob of the stage.

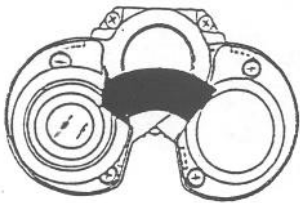
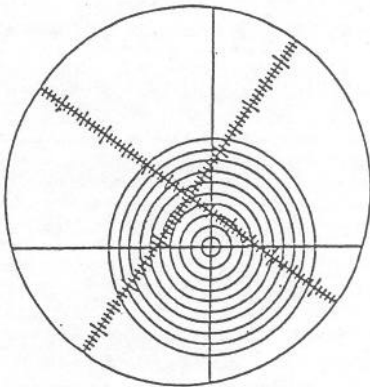
Before adjustment

After adjustment

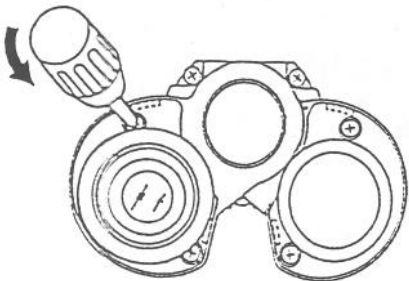
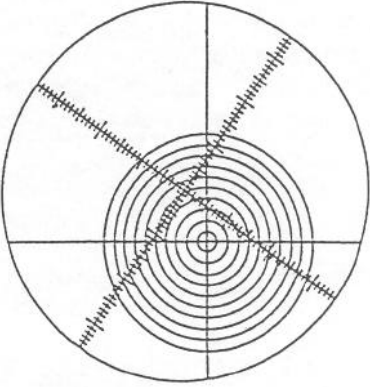
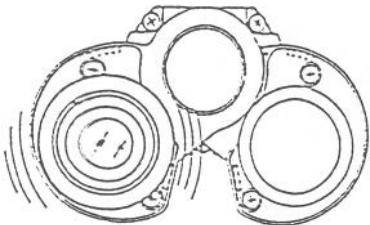
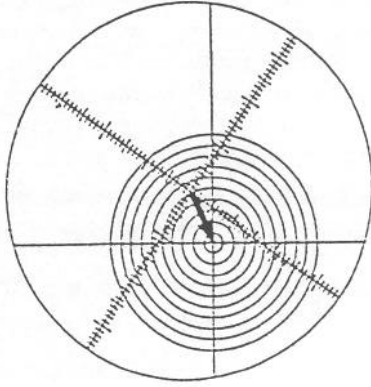


ADJUSTING THE LEFT/RIGHT OPTICAL AXIS

(1) Transfer the standard eyepiece to the left sleeve.

Work	Image seen through the standard eyepiece
<p>Transfer the standard eyepiece to the left sleeve.</p> 	<p>If the left/right optical axis is displaced, the cross hairs center of the standard eyepiece and the cross center of the specimen are displaced.</p> 

(2) Align the cross hairs center of the standard eyepiece with the cross center of the specimen.

Work	Image seen through the standard eyepiece
<p>i. Loosen the two screws slightly which secure the left sleeve.</p> 	<p>Image at first</p> 
<p>ii. Align the cross hairs center of the standard eyepiece with the specimen center while observing through the standard eyepiece. (Change the left sleeve position by hand.)</p> 	<p>The centers are aligned.</p> 

(cont.)

iii. Firmly tighten the two screws which secure the left sleeve.

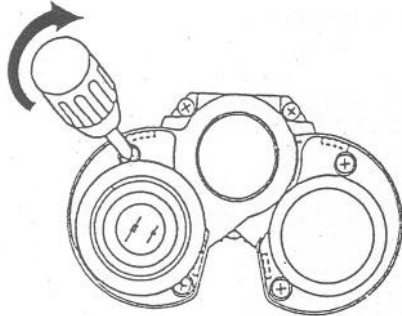
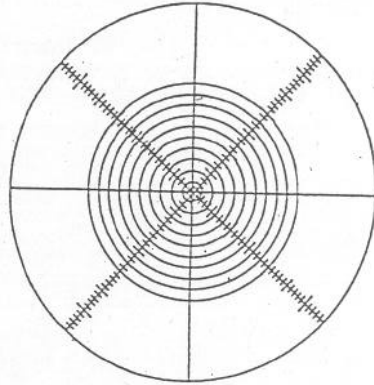


Image at the end of adjustment



CHECKING THE LEFT/RIGHT OPTICAL AXIS

Change the interpupillary distance as shown in Fig. A and check if the specimen center in the left sleeve is seen within the range shown in Fig. B.

Fig. A

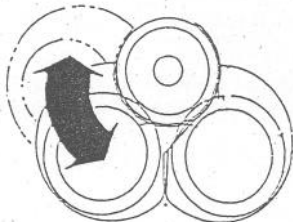
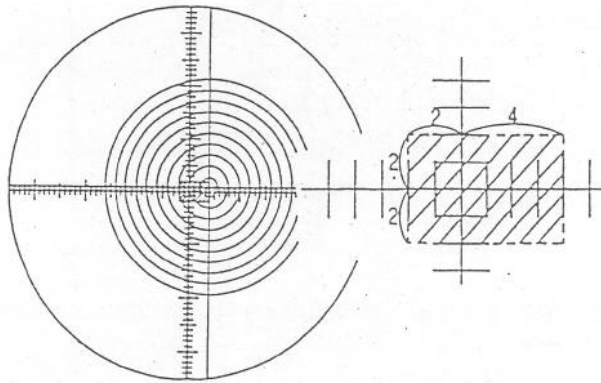


Fig. B

The specimen center in the left sleeve should be seen within the shaded area.



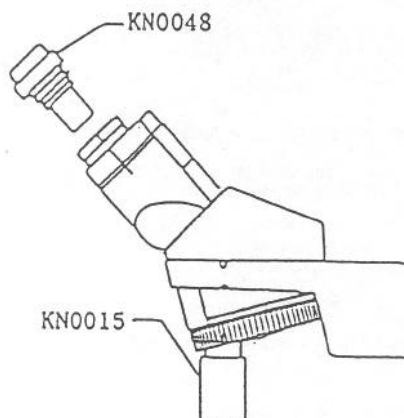
Magnified view of the center
(The center position is within the shaded area. Each numeric figure shows the scale of graduations.)

If the specimen center is not seen within the standard area, return to E-7 and repeat the adjustment.

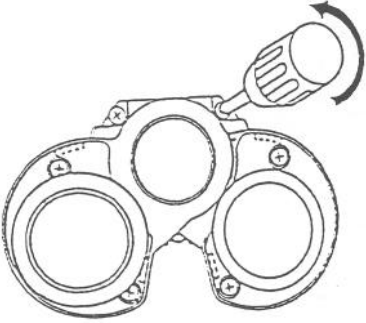
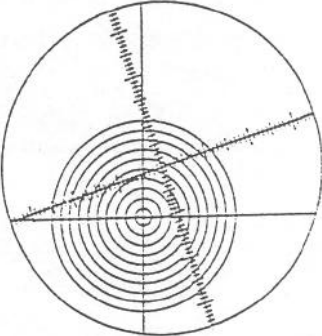
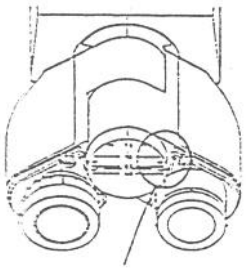
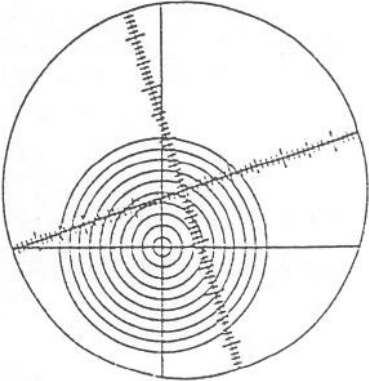
1-3 Adjusting the absolute optical axis (center of standard objective)

PREPARATION

※ Insert the standard eyepiece into the right sleeve.

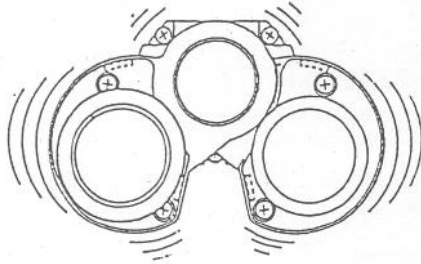


ADJUSTING THE ABSOLUTE OPTICAL AXIS

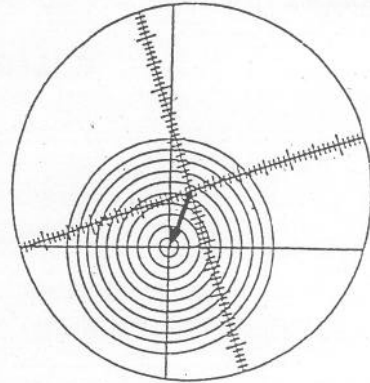
Work	Image seen through the standard eyepiece
<p>(1) Loosen the four screws slightly which secure the BI unit (to the extent that the unit does not become loose).</p> 	<p>If the absolute optical axis is displaced, the cross hairs center of the standard eyepiece and the cross center of the specimen in the standard objective are seen displaced.</p> 
<p>(2) Set the interpupillary distance to about 62 mm.</p>  <p>Position of about 62 mm</p>	<p>Image should not change so much.</p> 

(cont.)

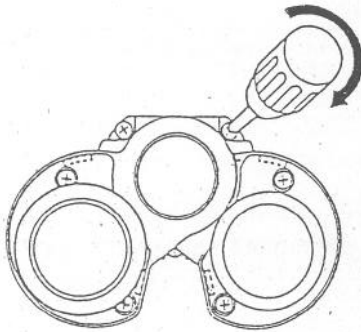
- (3) Align the cross hairs center of the standard eyepiece with the specimen center in the standard objective while observing through the standard eyepiece. (Change the BI unit position by hand.)



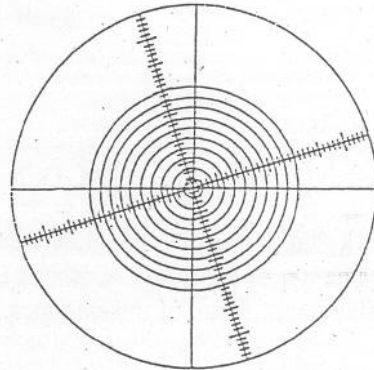
The centers are aligned.



- (4) Firmly tighten the four screws which secure the BI unit.



Be careful not to disturb the adjustment.



CHECKING THE ABSOLUTE OPTICAL AXIS

Change the interpupillary distance as shown in Fig. A and check if the specimen center in the right sleeve is seen within the range shown in Fig. B.

Fig. A

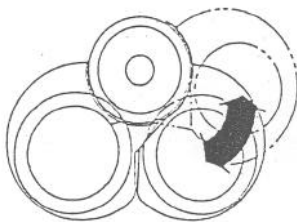
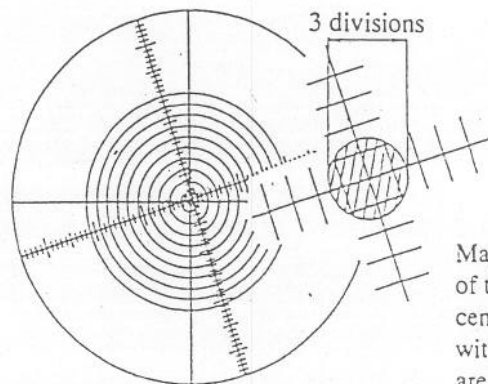


Fig. B

The specimen center in the right sleeve should be seen within the shaded area.



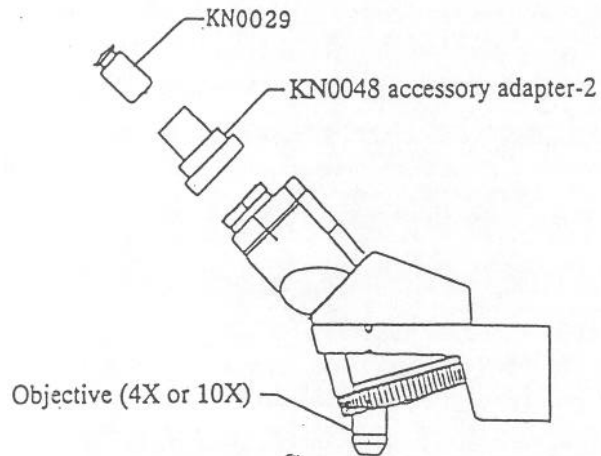
Magnified view of the center (The center position is within the shaded area.)

If the specimen center is not seen within the standard area, return to E-10 and repeat the adjustment.

1-4 Checking the exit pupil center

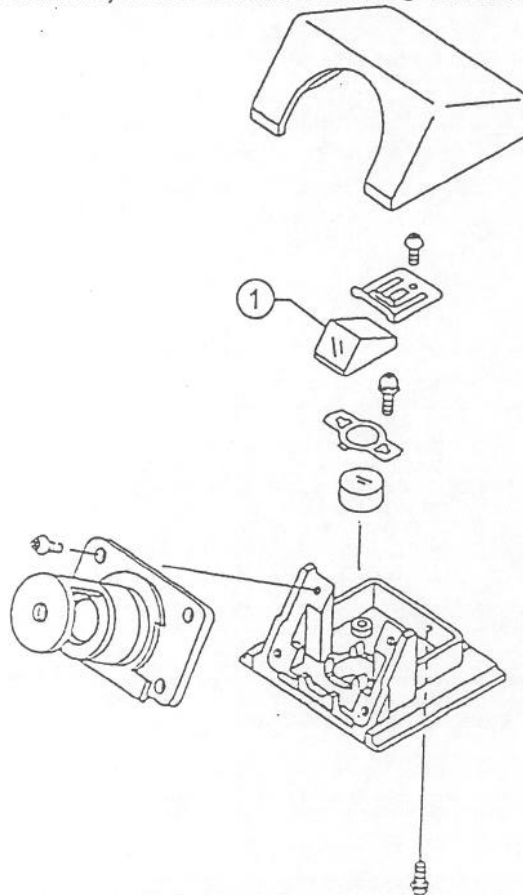
PREPARATION

※ Use the KN0048 accessory adapter-2 upside down.



CHECKING THE EXIT PUPIL CENTER

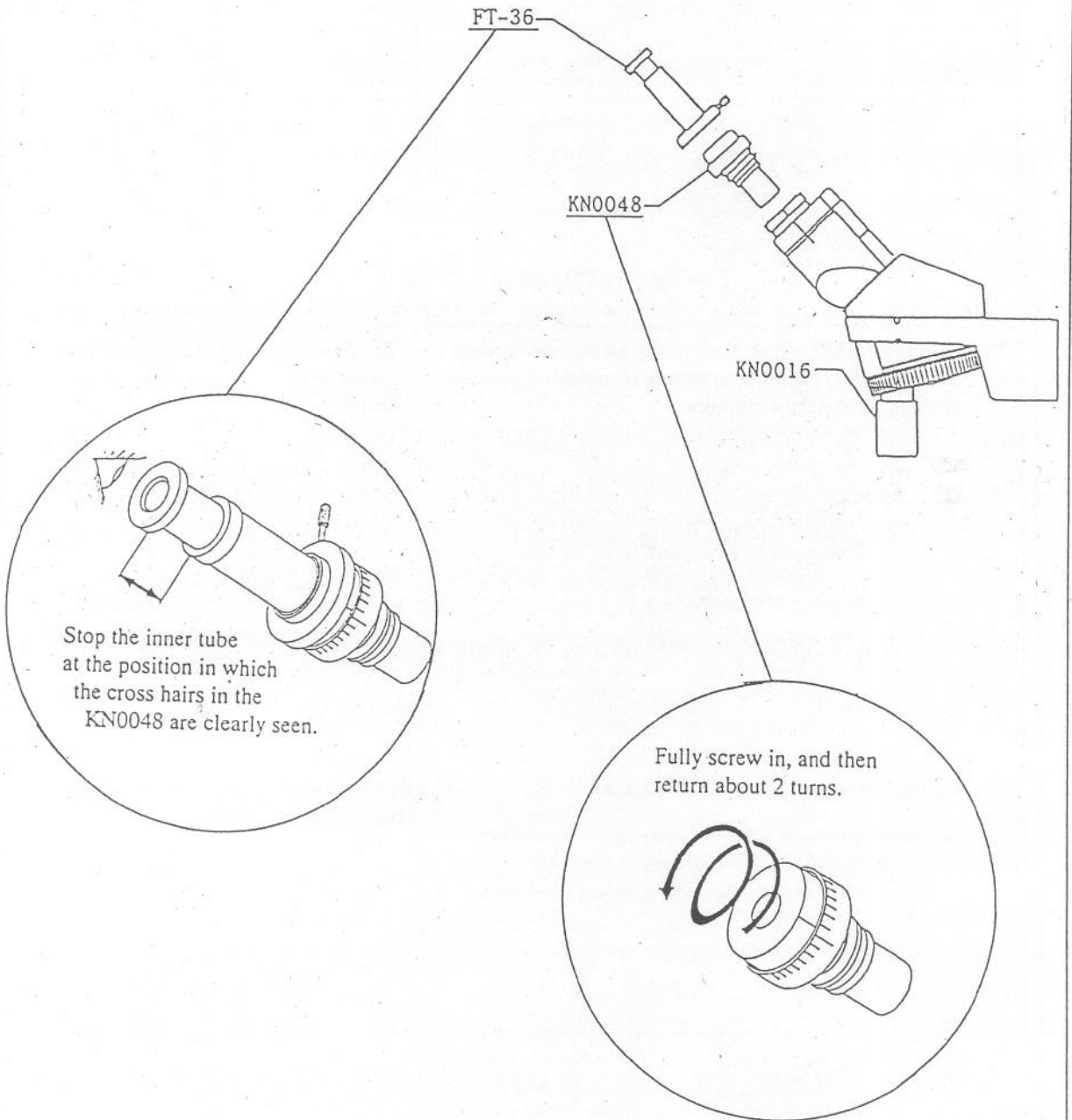
Check that the displacement between the center of objective's exit pupil diameter and the cross hairs center of centering telescope is within 20 % of the objective's exit pupil diameter. If the displacement is out of the standard, it indicates the PRISM ① is inclined or defective.



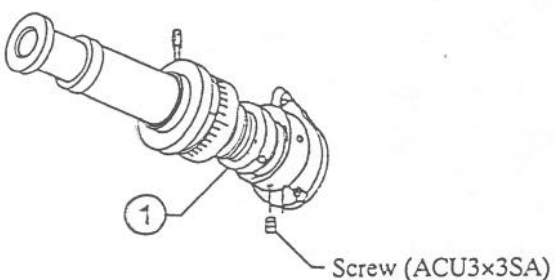
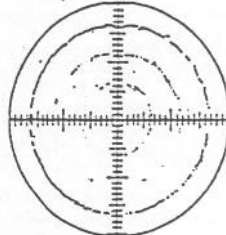
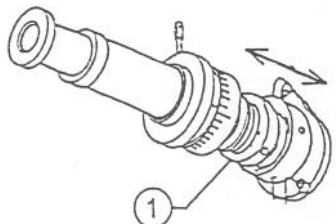
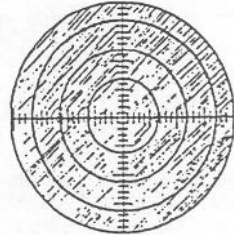
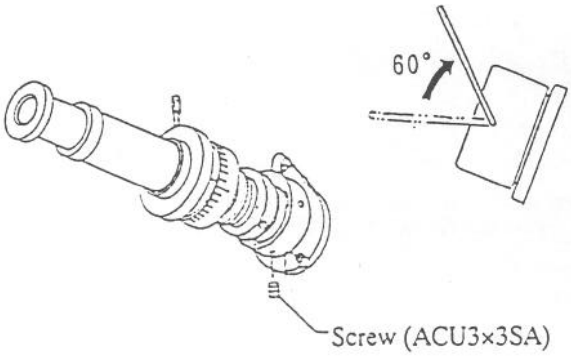
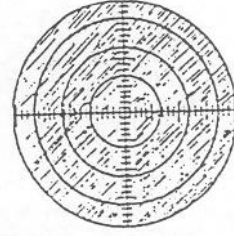
1-5 Adjusting the tube length

PREPARATION

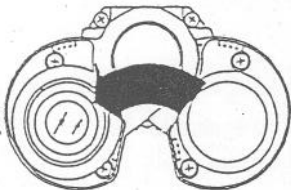
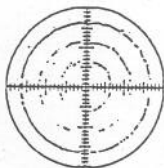
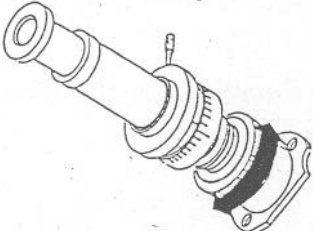

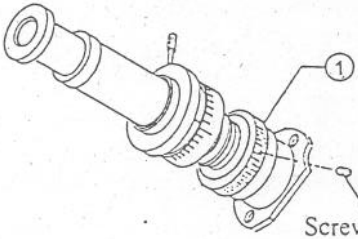
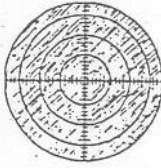
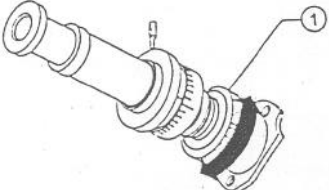
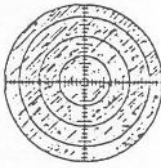
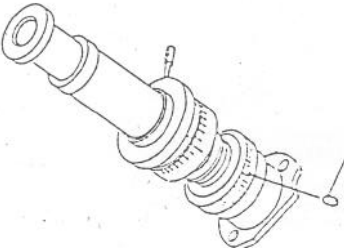
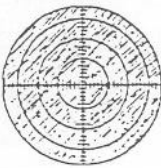
※ Insert the standard eyepiece into the right sleeve.



ADJUSTING THE TUBE LENGTH IN THE RIGHT SLEEVE

Work	Image seen through the standard eyepiece
<p>(1) Loosen the two screws which secure the SLEEVE-R ① in the right sleeve.</p> 	<p>The cross hairs of the standard eyepiece are clearly seen, but the specimen in the standard objective is seen unclear.</p> 
<p>(2) Adjust the SLEEVE-R ① vertically so that the specimen in the standard objective is clearly seen while observing through the standard eyepiece.</p> 	<p>The fine stripes in the background of the specimen are clearly seen at the best position.</p> 
<p>(3) Tighten the screws which were loosened in (1).</p> <p>※ Don't tighten the screws too strongly. The sleeve may be deformed. Turn the screw about 60° clockwise after the screw end contacts the sleeve.</p> 	<p>When tightening the screw, be careful not to disturb the adjustment.</p> 

ADJUSTING THE TUBE LENGTH IN THE LEFT SLEEVE

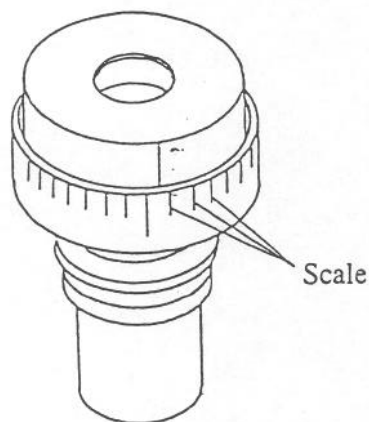
Work	Image seen through the standard eyepiece
<p>(1) Move all the jigs and tools which were used in the right sleeve to the left sleeve.</p> 	<p>The cross hairs of the standard eyepiece are clearly seen, but the specimen in the standard objective is seen unclear.</p> 
<p>(2) Adjust by turning the helicoid ring of left sleeve so that the specimen in the standard objective is clearly seen.</p> 	<p>The fine stripes in the background of the specimen are clearly seen at the best position.</p> 
<p>(3) Loosen the two screws which secure the SCALE RING ①.</p>  <p>Screw (ACU3×3SA)</p>	<p>When loosening the screw, be careful not to disturb the adjustment.</p> 
<p>(4) Keep the clear image of the specimen in the standard objective, move only the loosened SCALE RING ① and adjust "0" position of scale to the index.</p> 	<p>When turning the SCALE RING, be careful not to disturb the adjustment.</p> 
<p>(5) Tighten the two screws which were loosened in (3).</p>  <p>Screw (ACU3×3SA)</p>	<p>When tightening the screw, be careful not to disturb the adjustment.</p> 

CHECKING THE TUBE LENGTH

The cross hairs of the standard eyepiece and the specimen in the standard objective must be seen sharp at the same time. Even if the clearly seen positions are different, they must be within the standard range shown in Fig. A.

Fig. A Standard range indicated by scale

The clearly seen position difference between the cross hairs of the standard eyepiece and the specimen in the standard objective should be within 2.5 graduations on the helicoid scale of KN0048.



If the position difference is not within 2.5 graduations, return to E-13 and repeat the adjustment.

2. Adjustment of the Interpupillary Distance Working Force

2-1 Loosen the screws which secure the ADJ. SCREW ①.

Screw: ACU3X5SA 2 pcs. (*1)

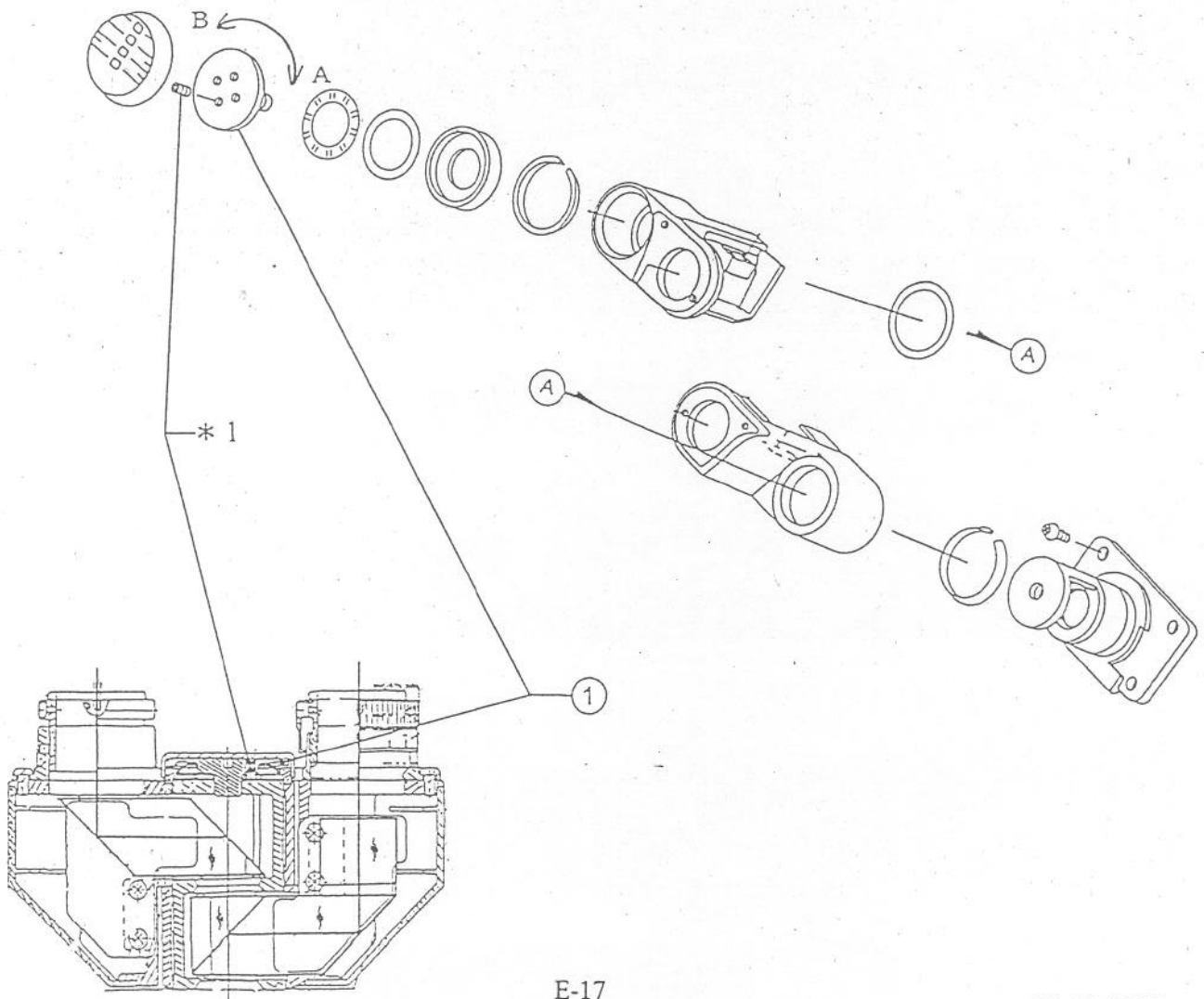
2-2 Turn the ADJ. SCREW ① in the direction A to increase the working force. Turn the ADJ. SCREW ① in the direction B to decrease the working force.

2-3 Tighten the screws of the ADJ. SCREW ① to fix the working force.

Screw: ACU3X5SA 2 pcs. (*1)

2-4 Measure the interpupillary distance working force, referring to the Chapter C. INSPECTION STANDARD.

Standard:	500 to 1200 g
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1. List of Jigs and Tools

No.	Description	Page
KN0003	* Test plate for stereo microscope alignment (5/100 mm concentric circles)	C-1, 2, E-2, 7
KN0015	LB standard objective for optical axis	C-1, 2, E-10
KN0016	LB standard objective for tube length	C-1, 3, E-13
KN0029	Centering telescope	C-1, 3, E-12
KN0048	Universal standard eyepiece with cross hairs	C-1 ~ 3, E-2, 7, 10, 13
	KN0048 accessory adapter-2	C-1, 3, 12
OT1068	Tension gauge (3 kg)	C-1, 2, E-17
FT-36	Focusing telescope	C-1, 3, E-13
	Microscope frame (product; CH30, CH40, etc.)	C-1 ~ 3, E-2, 7, 10, 12, 13
	Objective (product; 4x or 10x)	C-1 ~ 3, E-2, 7, 12
	* OB-M1/100SQ (product); Test plate (cross micrometer: OB-M#, 1/100 square)	C-1, 2, E-2, 7

* KN0003 or OB-M1/100SQ is used for the optical adjustment.

1. List of Lubricants

No.	Description	Page
OT1595	Silicone grease	D-2, 3

2. List of Chemicals

No.	Description	Page
OT1873	Silicone adhesive (black)	D-3