

UNIMET SERIES MR
METALLOGRAPHIC MICROSCOPE
INSTRUCTION MANUAL

UNION OPTICAL CO., LTD
TOKYO, JAPAN

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Based on the company's policy of putting special emphasis on the practical usefulness, ease of operation and economy, the UNIMET metallographic microscope has been designed for maximum performance and operating efficiency.

It is hoped that the user will read this manual carefully before operation and understand the performance and functions of this microscope so that its features can be fully exhibited.

I. STANDARD COMBINATION

SPECIFICATIONS OF MR1, MR2 AND MR3

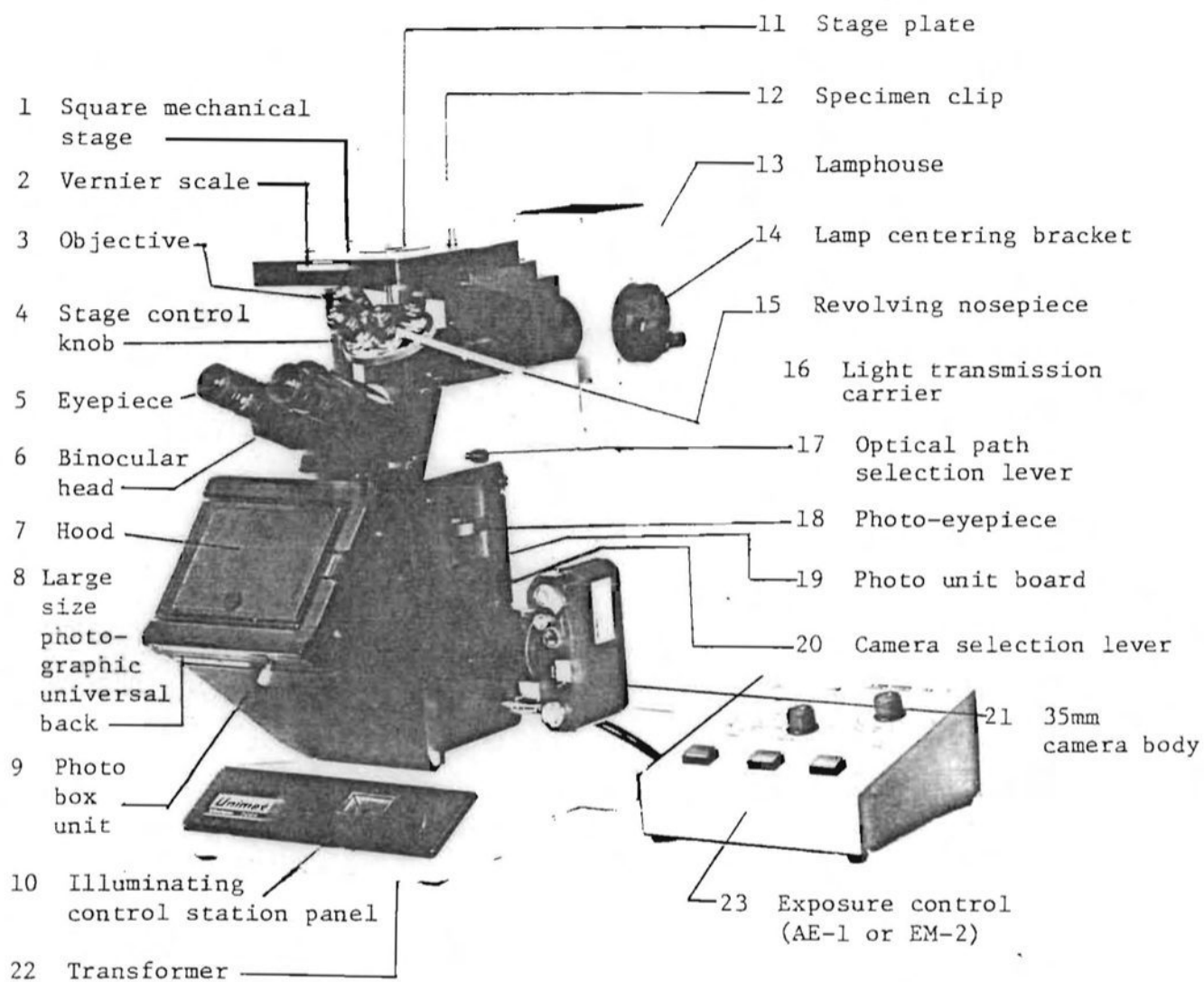
MODEL CODE	BRIGHTFIELD MODELS			BRIGHTFIELD/DARKFIELD MODELS		
	MR1-11	MR2-12	MR3-12	MR1-24	MR2-24	MR3-24
MICROSCOPE STAND	Inverted modular stand and large flat base, complete with built-in power supply transformer, light-intensity control, volt-meter, lamp changeover switch (for incident and transmitted light), output socket, etc.					
FOCUSING CONTROLS	Stage height adjustable by low-positioned coaxial coarse and fine focus controls. Coarse focus range: 50mm, fine focus range: 2mm but reading to 0.002mm increments for depth approximation.					
MECHANICAL STAGE	Graduated stage, 160 x 150mm in size offers 30 x 30 mm cross motion, reading to 0.1mm by vernier. Provided with low-positioned coaxial controls.					
BINOCULAR BODY	The bayonet-mounted body is hinged in the center and the right and left sections can be moved apart to vary the eyepiece separation.					
ILLUMINATOR	150W halogen brightfield illuminator complete with condensers, aperture diaphragm, and filters. Snap-in lamphousing is provided with a cordless, precentered bulb socket.			150W halogen brightfield/darkfield illuminator complete with condensers, field and aperture diaphragms, filters. Snap-in lamphousing is provided with a cordless, precentered bulb socket.		
POLARISING FILTERS	For the brightfield model, the polariser is mounted on movable slide, and for the brightfield/darkfield model the polariser is built into the darkfield selector. An analyser is provided with a lever and a graduated scale.					
OBJECTIVES	MF5x, MPL10x, MPL20x, MPL40x, MPL100x (dry)	MF5x, MF10x, MF20x, MF40x, MF80x	MF5x, MF10x, MF20x, MF40x, MF80x	Epitron EpiMF5x, EpiMF10x, EpiMF20x, EpiMF40x and MF80x		
EYEPIECES	New widefield eyepieces NW10x (offered in a paired set). Provided with soft plastic eyeguards.					
PHOTO-MECHANISM	Photo-relay module with optical path selector, built-in 4" x 5" view-screen camera with folding hood, turret-mounted 10x, 12.5x, 15x, 20x photo-lenses for plate photography, 3.3x lens for 35mm photography, built-in electromagnetic shutter and 35mm camera body (darkbox).					
EXPOSURE CONTROLS	A. MR1 - 11 and MR1 - 24 models are provided with an automatic control. B. MR2 - 12 and MR2 - 24 models are provided with an electromagnetic shutter control with manual exposure meter. C. MR3 - 12 and MR3 - 24 are provided with an electromagnetic shutter control.					
OTHER ACCESSORIES	Stage clip, 4 stage-insert plates (opening 10 ϕ , 15 ϕ , 20 ϕ mm graduated 20 ϕ mm), 3 double film holders (4"x5"), spare halogen bulb (24V, 150W) and primary cord.					

SPECIFICATIONS OF MR4

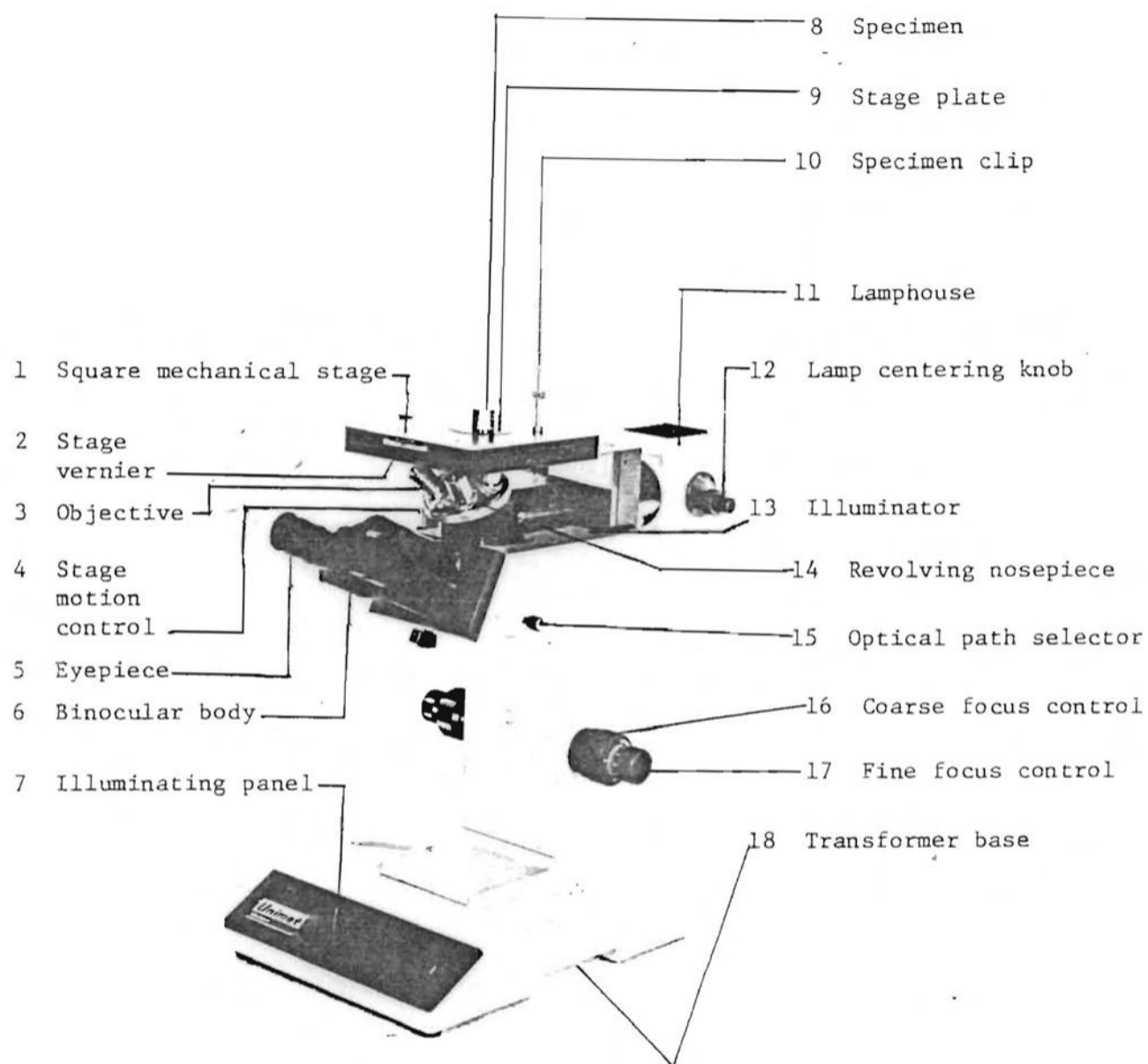
MODEL CODE	BRIGHTFIELD MODEL	BRIGHTFIELD/DARKFIELD MODEL
	MR4-12	MR4-24
MICROSCOPE STAND	Inverted modular stand and large flat base complete with built-in power supply transformer, light-intensity control, lamp changeover switch (for incident and transmitted light), output socket, etc.	
FOCUSING CONTROLS	Stage height adjustable by low-positioned co-axial coarse and fine focus controls. Coarse focus range: 50mm, fine focus range: 2mm, but reading to 0.002mm increments for depth approximation.	
MECHANICAL STAGE	Graduated stage 160 x 150mm in size offers 30 x 30mm cross motion, reading to 0.1mm by vernier. Provided with low-positioned coaxial controls.	
BINOCULAR BODY	Bayonet mounted binocular body is hinged in the center, and the right and left sections can be moved apart to vary the eyepiece separation.	
ILLUMINATOR	20W halogen brightfield illuminator complete with condensers, aperture diaphragm, and filters. Snap-in lamphousing is provided with a cordless, precentered bulb socket.	20W halogen brightfield/dark-field illuminator complete with condensers, field and aperture diaphragms, and filters. Snap-in lamphousing is provided with a cordless, precentered bulb socket.
POLARISING FILTERS	For brightfield model the polariser is mounted on a movable slide and for brightfield/darkfield models, the polariser is built into the darkfield selector. An analyser is provided with a lever and a graduated scale.	
OBJECTIVES	MF5x, MF10x, MF20x, MF40x and MF80x	Epitron EpiMF5x, EpiMF10x, EpiMF20x, EpiMF40x and MF80x
EYEPIECES	New widefield eyepieces NW10x (offered in a paired set). Provided with soft plastic eyeguards.	
PHOTO-MECHANISM	Photo-relay module with optical path selector	
OTHER ACCESSORIES	Stage clip, 4 stage-insert plates (opening 10 ϕ , 15 ϕ , 20 ϕ , graduated 20 ϕ mm), spare halogen bulb (6V, 20W) and primary cord.	

- Notes: 1. MPL flatfield objectives are super planachromatic type.
2. MF & EpiMF flatfield objectives are planachromatic type.

II. MR1, 2 NOMENCLATURE

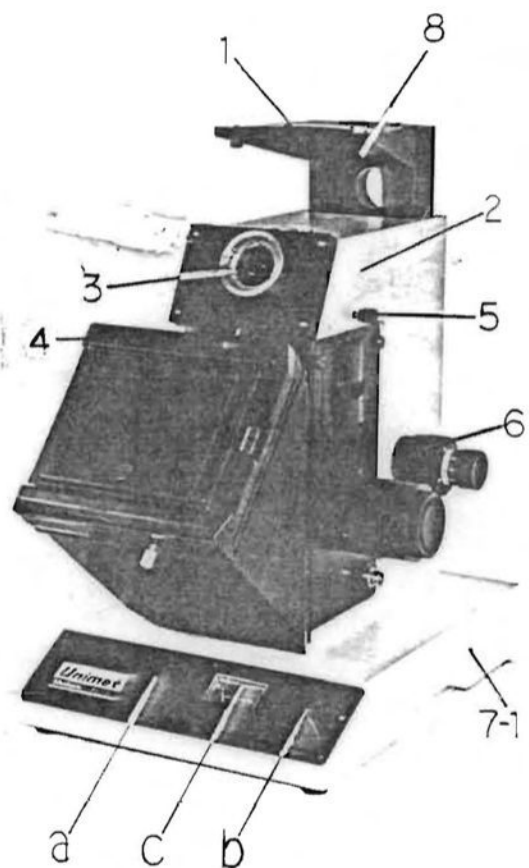


III. MR4 NOMENCLATURE

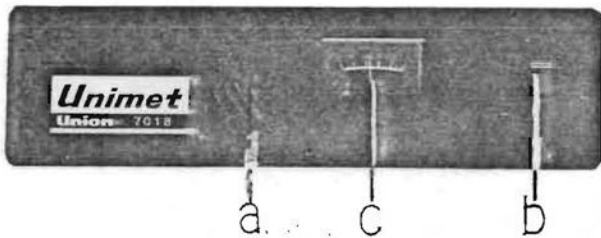


IV. STRUCTURE & FUNCTIONS

A. Microscope body



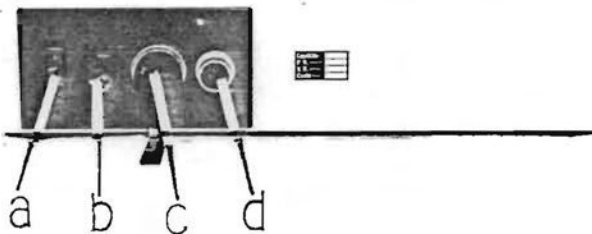
- 1 Stage bracket:
Attach the stage to this stage bracket and install it to the microscope body. Then the ball race stage bracket moves up and down by means of the coarse focus control knob and fine focus control knob.
- 2 Body frame:
The body frame houses a focussing mechanism. Install the light transmission carrier on the upper surface of the frame and the binocular head on the front.
- 3 Binocular mount:
Install the binocular head.
- 4 Clamp screw for mounting binocular head
- 5 Optical path selector:
Lever for changing over the optical path from visual observation to photography. Pulling this lever causes changeover to photography.
- 6 Coaxial coarse and fine focus control knob:
This is a coaxial knob using worm gears. The larger one is for coarse adjustment and stoppers are provided at the upper and lower limits. The coarse adjustment stroke is 50 mm and one rotation causes 7 mm movement.
The smaller knob is for fine adjustment and the stroke is 2 mm. One rotation causes 0.2 mm movement. The knob is provided with a fine movement scale and reading can be made up to 0.002 mm for one graduation.



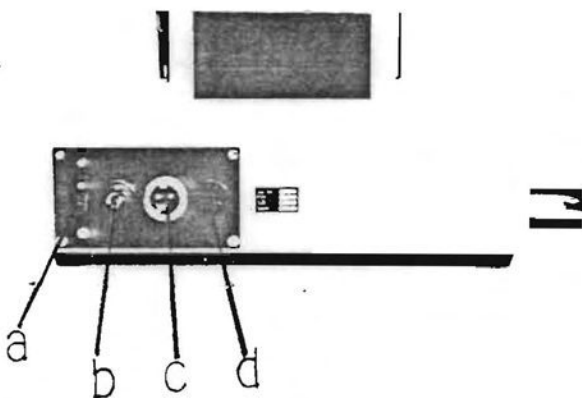
- 7-1 Base (MR1 and MR2) :
- The base self-contains a transformer.
- Illuminating control station panel
 - Light intensity adjustment knob:
This knob serves both as the main switch and dimmer.
 - Light intensity meter:
Indicates the lamp voltage level.



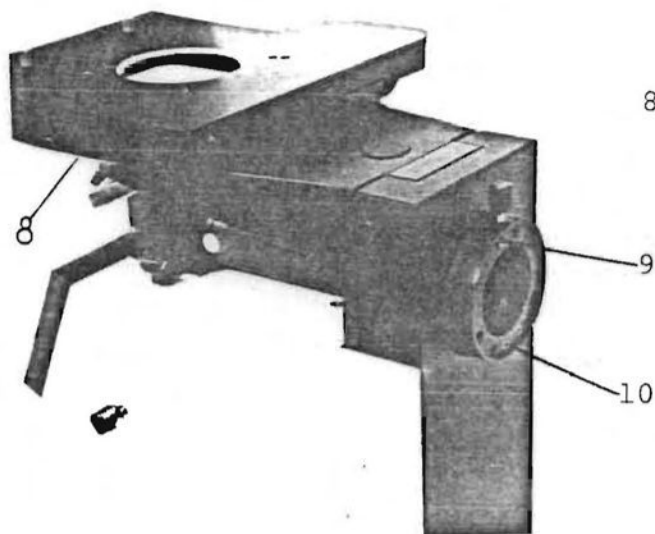
- 7-2 Base of MR4
- Illuminating control station panel
 - Light intensity adjustment knob:
This knob serves both as the main switch and dimmer.
 - Polot lamp:
The lamp lights up in red when the main switch is turned on.



- 7-3 Base rear panel of MR1 and MR2
- Illumination selection switch:
Illumination is changed over to reflection when the switch is thrown upward and to transmission when thrown downward.
 - Fuse holder:
A 3.0A fuse is enclosed.
 - Primary connector:
Connect the power cord from a V AC plug socket.
 - Transmission illuminator connector:
Secondary connector when the transmission illuminator is used. (12V, 50W halogen)



- 7-4 Base rear panel of MR4
- Illumination selector switch:
The illumination is changed over to reflection when the switch is thrown upward and to ransmission when thrown downward.
 - Fuse holder:
A 0.5A fuse is enclosed.
 - Primary connector:
The power cord is connected from a V AC plug socket.
 - Transmitted light illuminator connector:
Secondary connector when the transmitted light illuminating attachment is used. (6V, 20W halogen)



8 Stage fixing clamp screw:
The stage is fixed with four screws. The screw can be turned with a coin.

9 Lamphouse fixing screw:
The lamphouse is inserted and fixed with screws.

10 Lamp continuity pin:
Insertion of the lamp continuity pin causes power to be fed. This is designed in a cordless mechanism, which requires no secondary cord.

B. Light transmission carrier

1. Brightfield light transmission carrier (illuminator for brightfield observation)

1 Revolver cap:
This is removed when the objective lens is mounted.

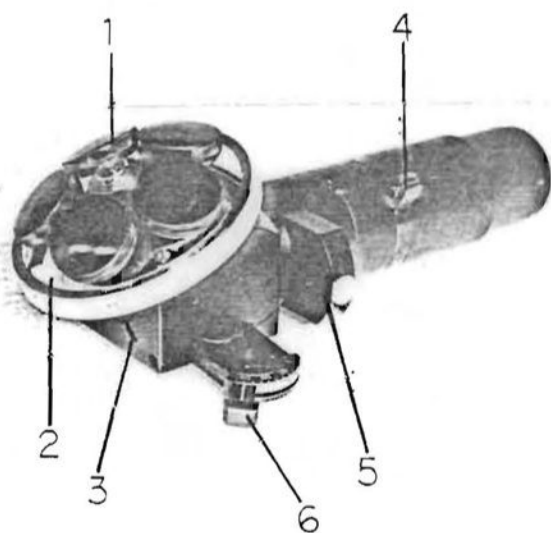
2 Revolving nosepiece:
This is a 5-position revolver on which five lenses are mounted.

3 Plane glass reflector:
The carrier self-contains a plane glass reflector.

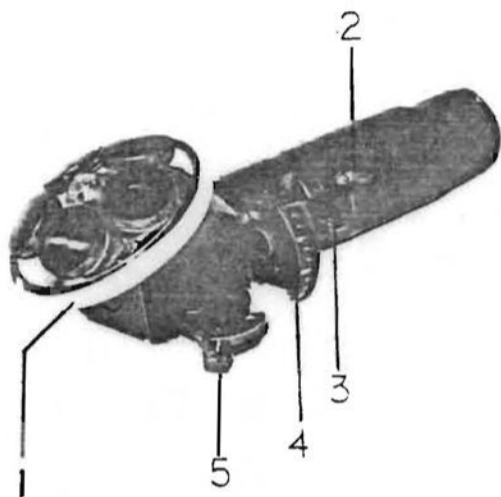
4 Aperture diaphragm "A":
Lever for light intensity control diaphragm.

5 Polarizer frame:
Self-contains a polarizer filter so called polarizer. The polarizer can be put in the optical path by inserting this frame.

6 Analyzer frame:
Self-contains a polarizer filter so called analyzer. The analyzer can be put in the optical path by inserting this frame. Used in conjunction with the polarizer, it permits observation by polarized light. The analyzer is provided with a 0 - 90° rotary scale for angular adjustment.

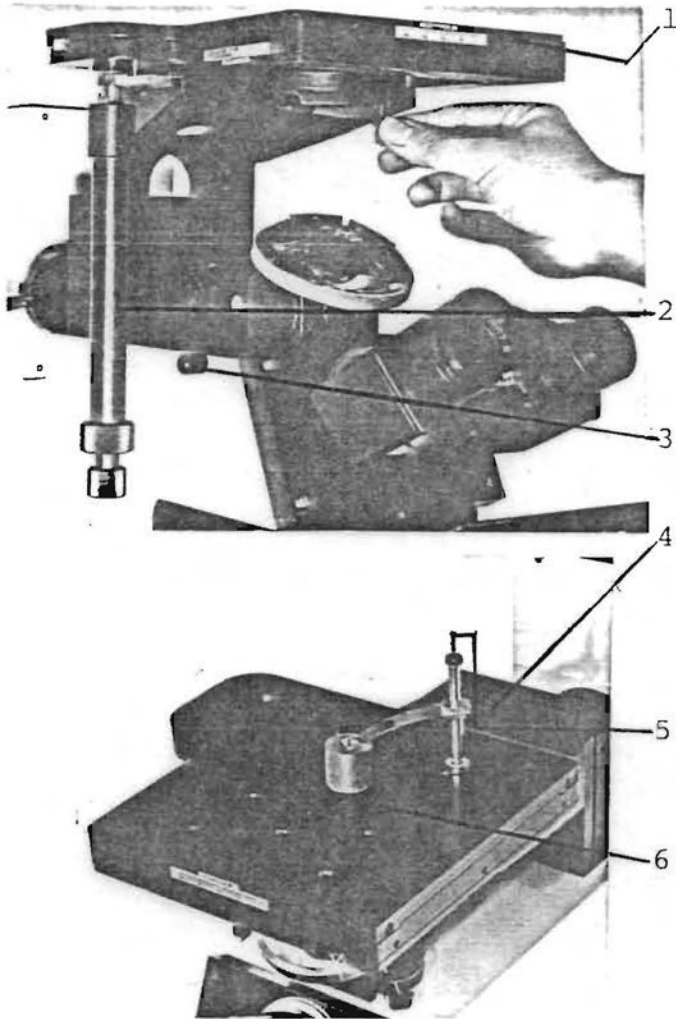


2. Brightfield/darkfield light transmission carrier
(illuminator for brightfield and darkfield observation)



- 1 Plane glass reflector:
The carrier self-contains a plane glass reflector.
- 2 Aperture diaphragm "A":
Lever for light intensity control diaphragm.
- 3 Field diaphragm "F":
Diaphragm to cut off harmful stray light outside the field of view.
- 4 Epi frame:
This self-contains an epi-contrast filter, which is used in observation by polarized light and observation by darkfield illumination. The epi-contrast filter can be rotated 0 to 90° by means of the lever.
- 5 Analyzer frame:
A polarizing filter so called analyzer is self-contained, which is used in observation by polarized light and observation by darkfield illumination. A 0 - 90° rotary scale is provided, which can be adjusted by means of the lever.

C. Square mechanical stage



Square mechanical stage:
X and Y axis travelling stage
The size of the stage surface
is 150 x 160 mm.

Stage travel

X axis: 30 mm, Y axis: 30 mm
Minimum reading is 0.1 mm on the
vernier.

Coaxial stage control knob:
Control for driving the X and Y
axes of the stage.

Light transmission carrier
clamp screw

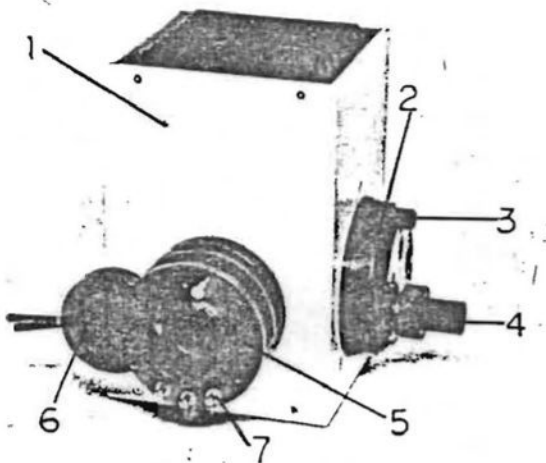
Fixing hole for transmitted
light attachment:
With this blind cover removed,
the support of the transmitted
light attachment is installed.

Specimen clip:
This holds the specimen to the
stage.

Stage plate:
In the center of the stage
there is a hole in which the
stage plate is to be fitted.
Depending on the specimen size,
install a stage plate of 10 ϕ ,
15 ϕ or 20 ϕ .

D. Lamphouse

- 1 Lamphouse:
Design consideration is given to permeability of this
lamphouse.
- 2 Lamp holder:
This includes a lamp socket and self-contains a lamp
centering mechanism.
- 3 Clamp screw for the above:
Clamp screw to fix the lamp holder in the lamphouse.
For lamp replacement, loosen this to remove it.

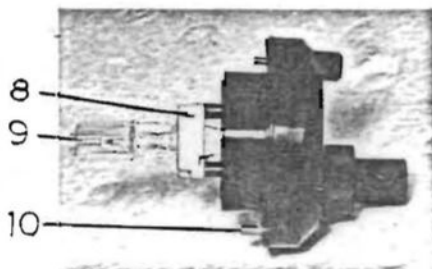


4 Lamp centering knob:
Coaxial knob for lamp centering.
The larger knob moves the filament on the X axis in the field of view and the smaller one permits adjustment in the vertical direction.

5 Filter holder:
This allows swinging the filters in and out. This also serves as a fixing mount.

6 Filter:
Two filters of green and blue are mounted.

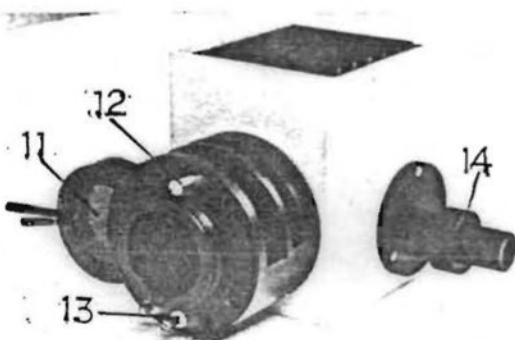
7 Electric connection pins:
Metal pins to be used in leading the electric current from the body to the lamphouse.



8 Lamp socket:
Porcelain socket for the halogen lamp

9 Halogen lamp:
12 V, 150 W for MR1, MR2

10 Lamp holder positioning pin:
A guide pin for fixing lamp holder position to the lamphouse



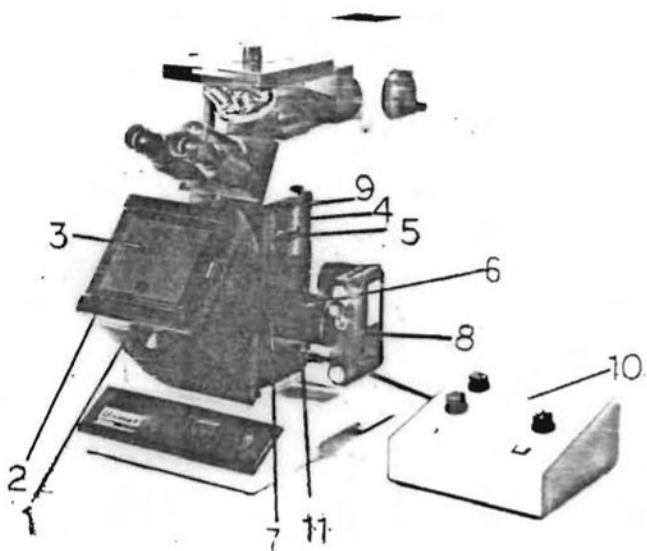
11 Filter:
Two filters of green and blue colors are mounted.

12 Guide pin for fixing lamphouse position:
When installing the lamphouse to the body, this pin is fitted into the pin slot on the body.

13 Electric connection pins:
Metal pins to be used in leading electric current from the microscope body.

14 Lamphouse centering knob:
Coaxial knob for lamp centering. The larger knob moves the filament in the X axis in the field of view and the smaller knob permits adjustment in the vertical direction.

E. Photo-mechanism (MR1, MR2)

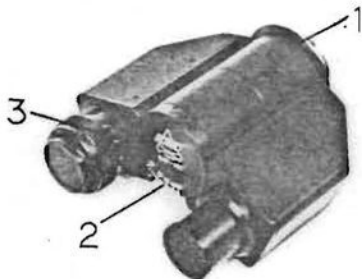


- 1 "Photobox" unit:
All elements of the photo-mechanisms on MR1 and MR2 are housed.
- 2 Large-size photographic universal back:
Accepts (3 x 4)" or (4 x 5)" sheet film holder and Polaroid #405 holder (3 x 4)" and #545 holder (4 x 5)".
- 3 Hood:
Hood for focussing screen available for large-size film photography. Designed in a holding type, it can be opened and closed by flick of a button.
- 4 Photo unit board:
On this board are installed the photo-eyepieces for photography (with turret), electromagnetic shutter, light receptor element, prism for 35 mm photography, 35 mm camera fitting tube, etc.
- 5 Photo-eyepieces:
Five phot-eyepieces -- 3.3x for 35 mm photography, 10x, 12.5x, 15x and 20x for large size photographs -- are mounted on the turret. The photo-eyepieces are changed over by rotating the knurled collar on the outside, and the lens magnification can be checked through the magnification display window.
- 6 35 mm camera mounting tube:
Tube to which a 35 mm camera is to be mounted. It self-contains a rectangular prism.
- 7 Camera selection knob:
Knob for moving the rectangular prism self-contained in the 35 mm camera tube, in and out of the optical path. With the prism moved in the optical path, the path is changed over to the 35 mm camera. With the prism moved out of the path, it is changed over to large size film photography.
- 8 35 mm camera body:
Exclusive 35 mm dark box body is provided as standard accessory.

(But, sometime it is omitted according to customer's request.)

- 9 Tightening screws:
Screws for fixing the photo unit board. When the macro photo-mechanism attachment is used, loosen the screws and take out the photo unit board. The screws can be tightened with a coin.
- 10 Exposure control:
Automatic exposure control and semi-automatic exposure control are available.
- 11 Plug for the cord of exposure controller:
Plug for connecting the exposure controller. The self-contained electromagnetic shutter and light receptor element can be controlled by connection to the plug.

F. Binocular head

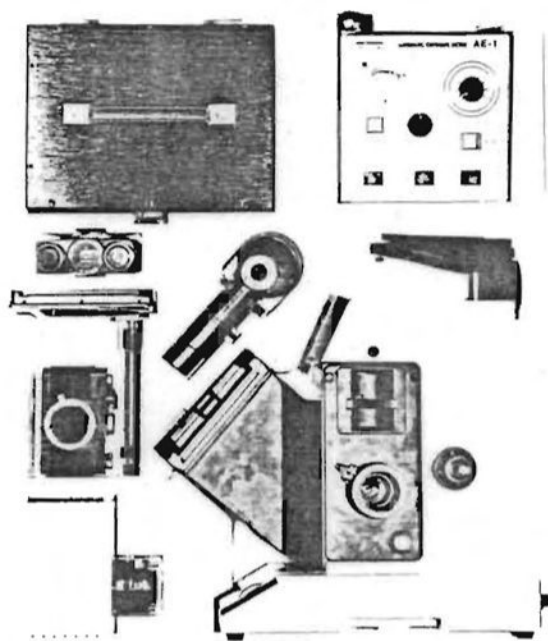


- 1 Binocular head mount:
Mount to install the binocular head to the body frame of the microscope, with a round dovetail groove.
- 2 Interpupillary scale:
The interpupillary distance can be adjusted within a 56 - 75 range. Being of the Siedentopf type, the magnification does not change by changing the interpupillary distance.
- 3 Diopter adjusting knurled collar:
The diopter difference between the right and left sections of the binocular head can be adjusted. The diopter of the right and left sections have been adjusted at the 0 position of the scale.

V. UNPACKING

The microscope is packed with foamed plastic materials so as to prevent it from possible damage during transit. In unpacking the case, be careful not to lose even a single part, checking one by one.

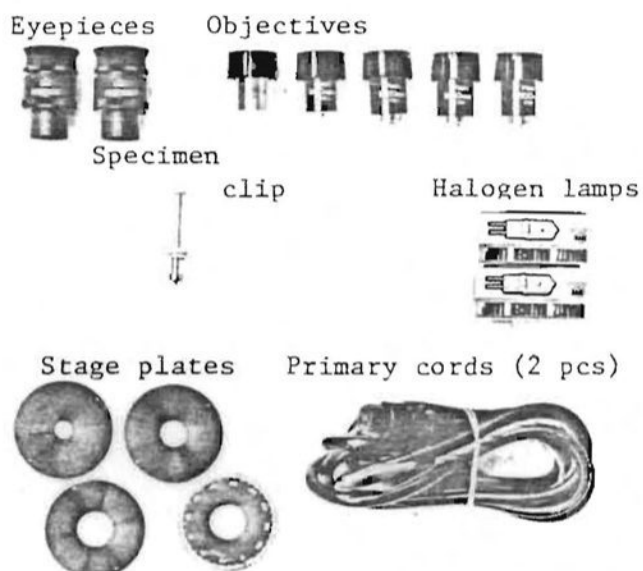
A. MR1 and MR2



B. MR4

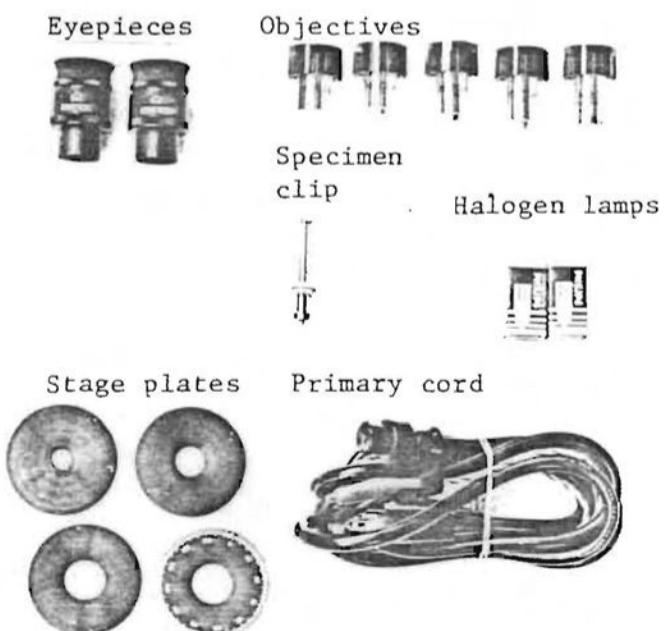


Parts accommodated in the parts case



Parts accommodated in the parts case

Parts case

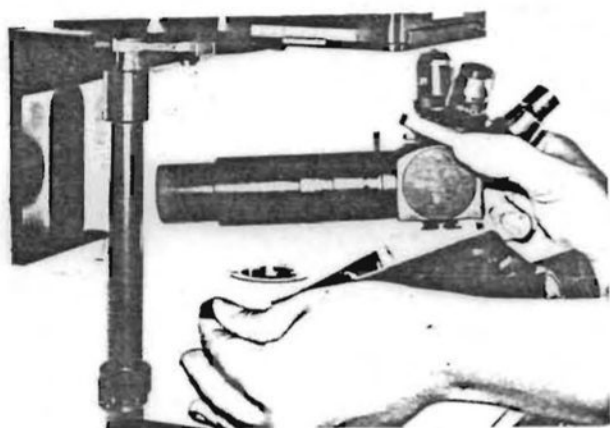


VI. ASSEMBLING THE MICROSCOPE

A. Precautions in installing the microscope

The microscope is a precision optical instrument and its delicate mechanism is very sensitive to vibration. So install it in a place free from vibration and on a rigid desk not susceptible to vibration. Also avoid a humid or dusty place. Do not install it in direct sunlight or in a place where temperature changes drastically such as in the vicinity of a room heater.

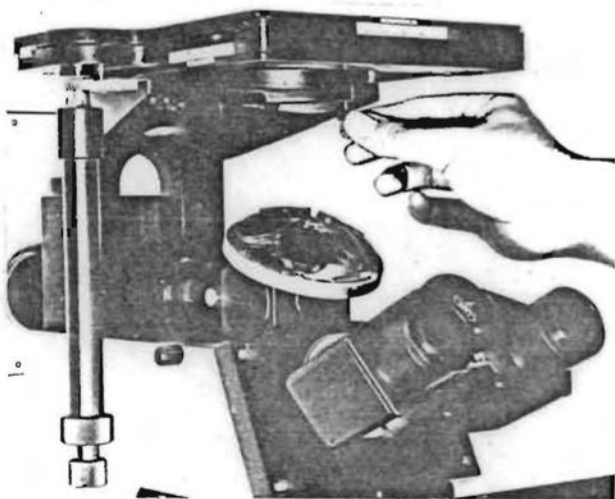
B. Installing the light transmission carrier



Clamp screw

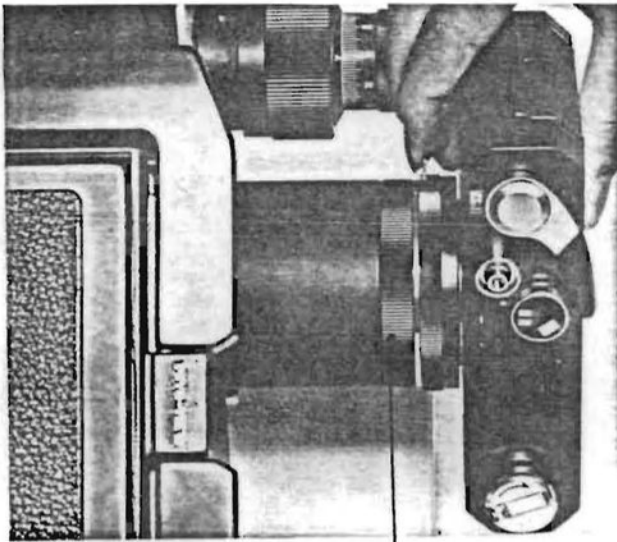
- (1) Take out the microscope body and place it on a desk on which the microscope is to be installed.
- (2) Raise the stage bracket all the way by means of the coarse focus control. Then with the tail of the carrier inserted into the top round hole of the bracket as shown in the figure, engage the round dovetail of the bottom of the carrier with the dovetail groove on the upper surface of the body frame and fix it securely with the clamp screw.

C. Installing the cross motion stage



- (1) Place the stage on the stage bracket as shown in the figure and fix it with the accessory clamp screw. This can be done with a coin.
- (2) Remove the two red screws on the upper surface of the stage plate.

D. Installing the 35 mm camera body (MR1, 2)

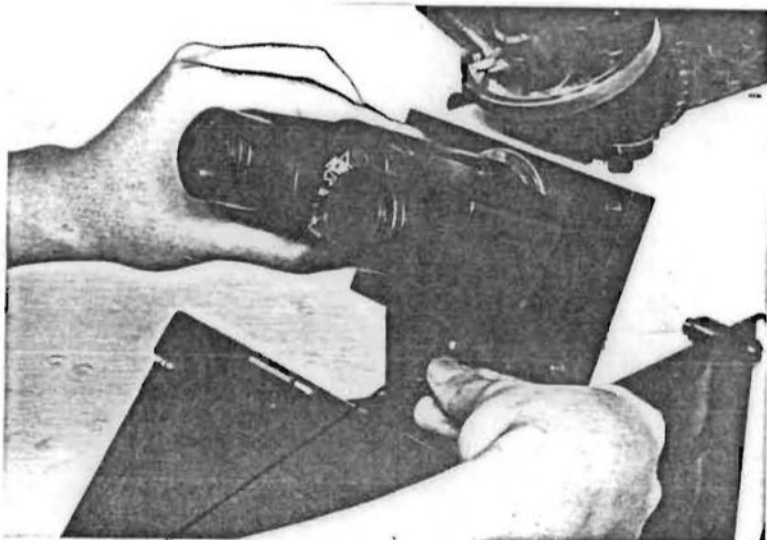


Set-screw

Note: For the handling of the camera body, refer to the attached instruction manual of the camera body.

- (1) With the red dot of the camera mount and the red dot (mark) of the mount for attaching to the microscope body matched, press the camera to the body. Here, the mounts are engaged with each other. With the camera pressed, turn it clockwise to set in a vertical position, and the fixing pin will click into the slot and the camera can be securely set in position.
- (2) To remove the camera, turn the lever of the fixing pin to the side of the camera body, turn it clockwise, and the camera can be easily taken out. To change the camera position or to use the camera in a horizontal position, loosen the three set-screws of the peripheral knurled collar of the camera mount on the microscope body side.

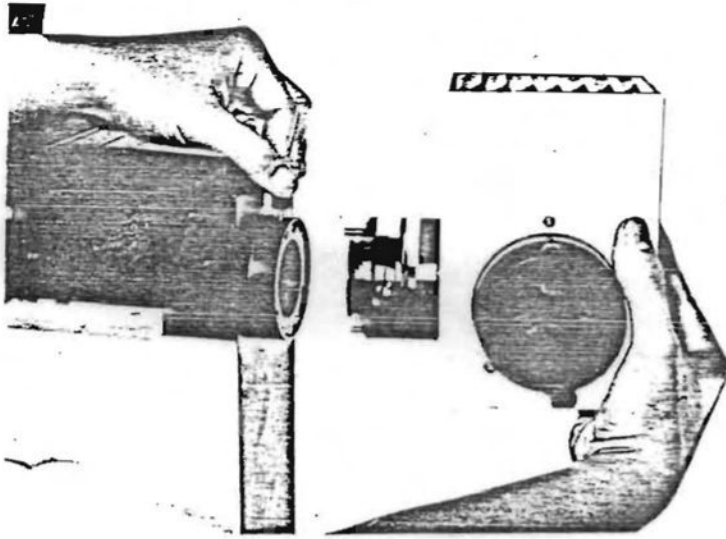
E. Installing the binocular head



Clamp screw

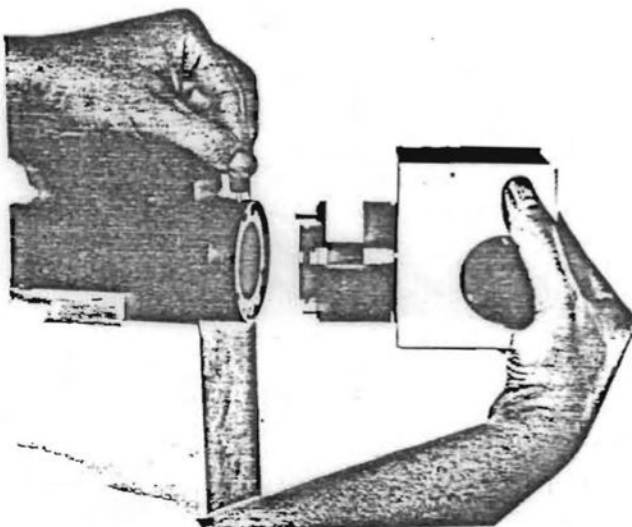
- (1) Remove the cap of the mounting portion of the binocular head, match the binocular head to the round dovetail groove of the microscope body mounting section of the microscope body as shown in the photo, and fasten it with the lower clamp screw.

F. Installing the lamphouse



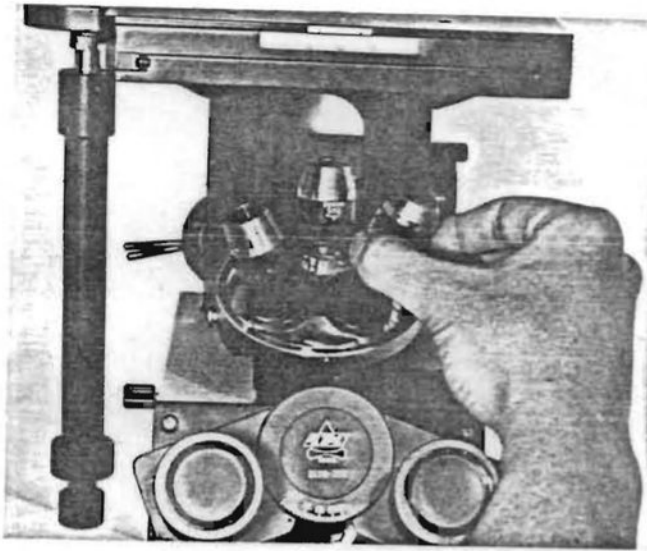
MR1,2

- (1) With the lamphouse held in parallel to the lamphouse mounting section on the upper rear of the microscope body, insert the positioning pin slowly as shown in the figure and then insert the electric connection pin to fix the lamphouse. After the insertion, securely fix the lamphouse with the clamp screw.



MR4

G. Mounting the objective lenses

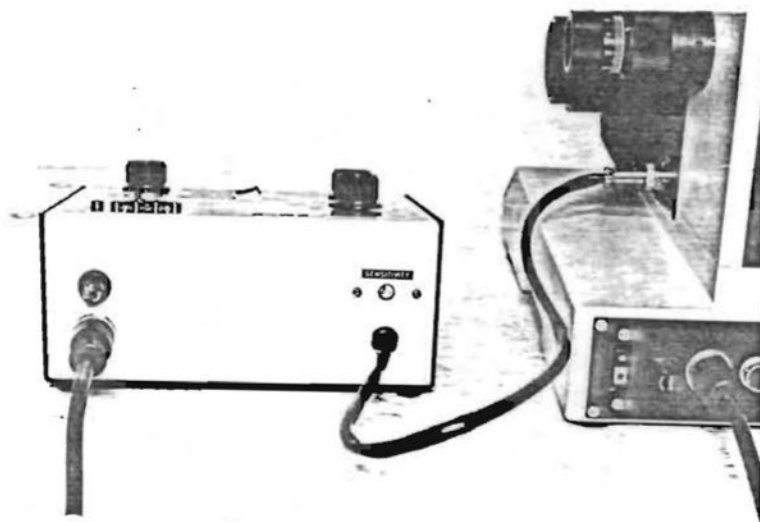


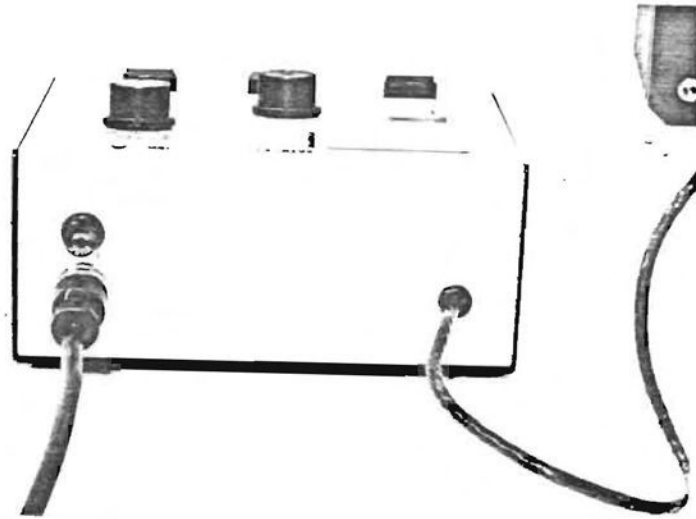
- (1) Wipe off dust on the revolving nosepiece and remove the cap.
- (2) Mount the objective lenses in the order of 5x, 10x ...

H. Installing the exposure controls

Installing the exposure controls (AE-1, EM-2) of MR1 and MR2

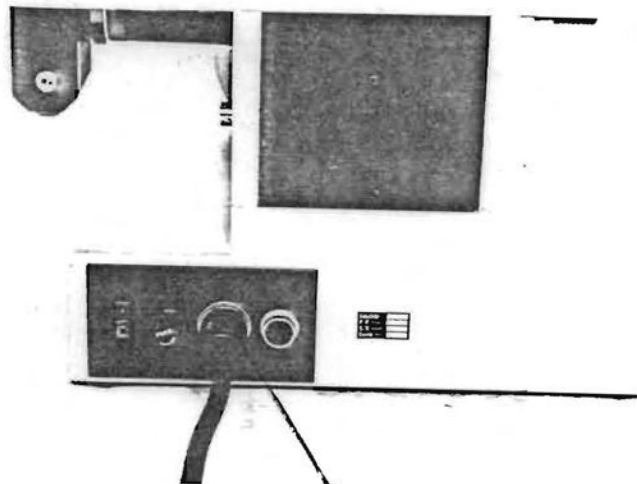
On the rear of the AE-1 or EM-2 are provided an extractable cord for connection to the microscope main body as well as a socket to accept an AC cord. Connect the plug of the accessory AC cord and the extractable cord to the socket in the right side bottom of the photo unit board of the main body.





I. Connection of cord

Because of the cordless mechanism, the microscope needs no bulb cord. So all you do is just connect the AC primary cord.

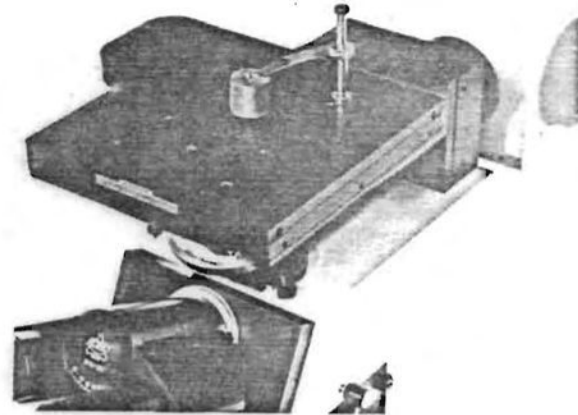


Primary cord

VII. PRACTICE OF OBSERVATION

A. Mounting of a specimen

- (1) Make sure the specimen is not deflected to either side, back and forth or right and left, and drop the stage plate in the center of the stage. In installing the stage plate, select one of the appropriate size according to the specimen size.
- (2) Place a specimen having appropriate reflectivity, for example, metal specimen subjected to etching, in the center of the stage plate.
- (3) Lightly hold the specimen with the specimen clip. With the tip of the clip put on the specimen upper surface, press the sliding section of the clip downward, and the specimen is held tightly to the stage.



B. Focussing

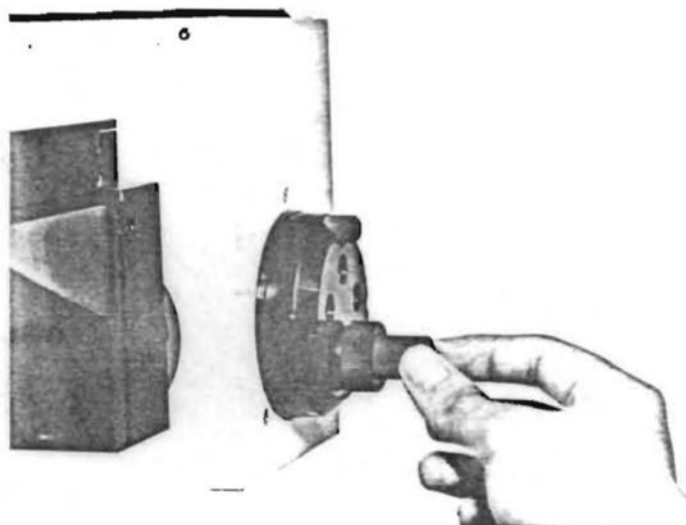
- (1) Rotate the revolving nosepiece so that a lower power objective (5x or 10x) come into the observation position.
- (2) Lower the stage to the lowest position by means of the coarse focus control. Rotate the right fine focus control until the circumferential line comes in contact with the edge of coarse focus control. (There is a lower limit stopper.)
- (3) Bring the specimen surface into focus by means of the fine focus control knob.
- (4) Then change the objective to greater magnification by rotating the revolving nosepiece and select the intended magnification. Since the objective have been adjusted parfocally, focussing can be done by minor manipulation of the fine focus control knob when the objective is changed.

C. Centering of lamp

- (1) Regulate the "A" aperture diaphragm to a minimum for

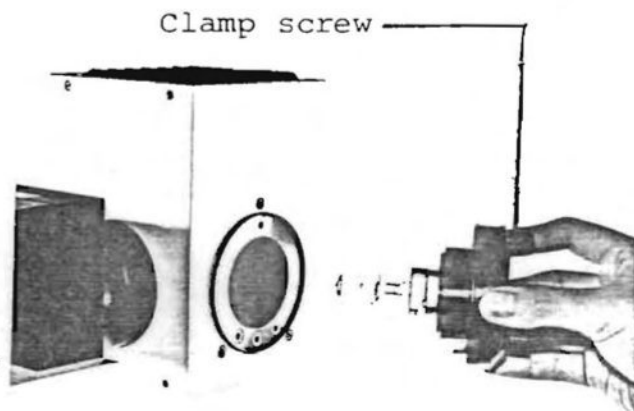
both the brightfield and brightfield/darkfield models. For the brightfield/darkfield model, swing out the polarizer and analyzer from the optical path for brightfield observation.

- (2) Turn upward the main switch for the illuminating transformer on the front panel of the base to increase the light intensity to an appropriate level.
- (3) With the specimen in focus, observing through the eyepiece, make adjustment by manipulating the lamphouse centering lever so that there is no unevenness in the brightness in the center portion of the field of view.
- (4) The centering knobs are coaxial, of which the larger knob permits adjustment of the filament in the field of view to right and left (X direction) (clockwise rotation causes the filament to move to right and counterclockwise rotation to left) and the smaller knob permits up and down adjustment of the filament in the field of view.



Note: Replacement of lamp

For MR1 and MR2:
To replace the lamp, remove the clamp screw in the upper part of the centering knob mounting portion, which is a socket, by loosening it, and the lamp can be replaced through the socket hole. Securely insert the connecting pin of the lamp into the lamp mounting insulator.



For MR4:

Open the lamphouse cover upwardly as shown in the photo and replace the lamp.



D. Interpupillary adjustment and diopter adjustment of the binocular head

The diopter of our right and left eyes may vary from time to time depending on conditions. There is also a difference in the interpupillary distance from one person to another. If adjustment of the interpupillary distance and diopter has been made perfectly, the advantages of the binocular head will be fully exhibited but also strains on eyes that may be caused by observation will be significantly reduced.

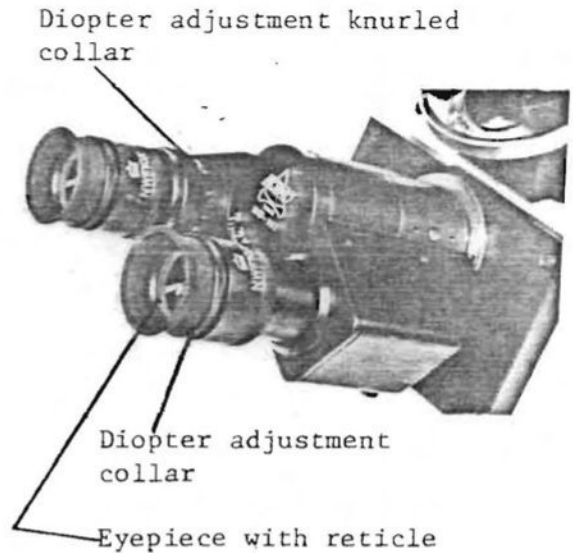
(1) Interpupillary adjustment

- o This binocular body is designed in a Siedentopf type, so that the optical path length does not change at all with change in the interpupillary distance.
- o Hold the right and left tubes of the binocular head with both hands and adjust the interpupillary distance looking through the tubes with both eyes so that the right and left fields of view superimpose into one. When the interpupillary adjustment has been done perfectly, the field of view will be a large circle.

(2) Adjustment of diopter

- o Look through the right eyepiece with the right eye, and a scale will be seen in the field of view. Pull out the eyepiece diopter adjustment collar and make adjustment until the scale lines can be seen clearly.
- o Place the specimen on the stage and make precise focus adjustment by means of the fine focus control knob through the right eyepiece.

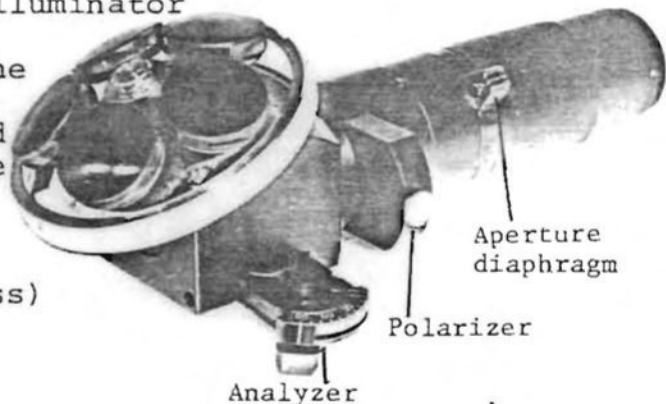
- o Look through the right and left eyepieces simultaneously with both right and left eyes. If the right and left focussed images do not seem superimposed together in focus, pull out the diopter adjustment knurled collar for the left eyepiece and make adjustment until the right and left images are superimposed completely but do not manipulate the fine focus control knob.
- o Check again if the interpupillary adjustment has been done completely.



Also a polarizer can be inserted into the slot of the light transmission carrier outer tube and an analyzer into the lower part of the same carrier.

E. Use of the brightfield illuminator

The field diaphragm of the brightfield transmission carrier is self-contained and is fixed to match the eyepiece. On the outer tube of the carrier is provided "A" knob, which is an aperture (brightness) diaphragm.



(1) Aperture diaphragm

The aperture diaphragm has two functions of adjusting the quantity of the illuminating light intensity and adjusting the depth of focus.

Set the aperture diaphragm to an optimum aperture according to the numerical aperture engraved on the objective lens to be used. When a high power objective lens such as MF80x or Plan M100x is used, it is necessary to control the diaphragm to near "MIN".

In photography, control of the diaphragm slightly more than normal increases the image contrast and depth of focus and reduces blurring around the image. However, note that excessive control will decrease the resolving power.

(2) Brightfield observation

For brightfield observation it is necessary to remove the polarizing filter equipped in the microscope from the optical path. As shown in the photo, the polarizer is out of the optical path when it is pulled to the right. Likewise, the analyzer is out of the optical path when it is pulled out.

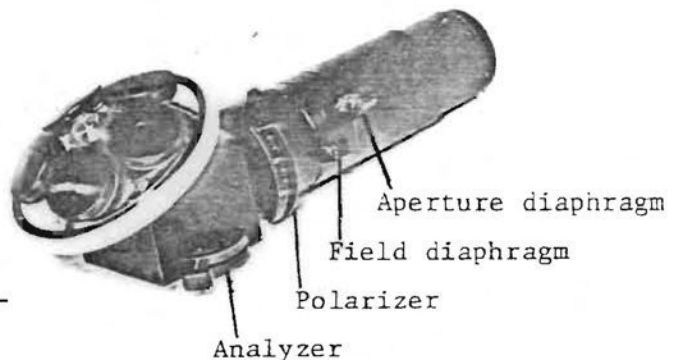
(3) Observation by polarized light

The brightfield is effective in the observation of specimen that tends to produce poor contrast, detection of anisotropic substances, observation of very small area of crystals, minerals, metals and others. Insert the polarizer and analyzer into the optical path. The analyzer is graduated with a 0 - 90° scale and can be rotated by means of a lever.

F. Use of brightfield illuminator

The brightfield illuminator has a aperture diaphragm and a field diaphragm. It is also equipped with a polarizer and analyzer to be used in polarizing and darkfield illumination.

This illuminating method permits quick changeover from the brightfield to polarization or from brightfield to darkfield illumination but also continuous changeover from the brightfield to the polarization, intermediate contrast and dark-field illumination by simple operation.



- (1) The following table shows the operation in different illumination modes

Operation \ Illumination	Brightfield	Polarization	(Intermediate contrast)	Darkfield
Field diaphragm "F"	Control to effective field of view	Same as left column	Fully open	Fully open
Aperture diaphragm "A"	Control according to the N.A. of objective lens	Same as left column	Same as left column	Fully open
Analyzer	Set it outside the optical path (Pull to left.)	Bring it in optical path and set it to 90° scale.	Set it outside the optical path.	Set it outside the optical path.
Polarizer	Set it outside the optical path (Pull to right.)	Bring it in the optical path and set it to 0° scale.	Bring it in the optical path and	Bring it in the optical path and set it to 90° scale.

Use this table in operating these components for different illuminating modes.

- (2) Intermediate contrast

The UNIMET uses a unique Epitron system for brightfield/darkfield illumination. With the ordinary darkfield illuminator, the image once disappears from the field of view completely when the brightfield is changed over to the darkfield, but the Epitron system permits observation of continuous changes in contrast from the brightfield to the intermediate image of the brightfield/darkfield and to the darkfield. The continuous changes in contrast can be freely controlled by rotating the polarizer (epicontrast filter).

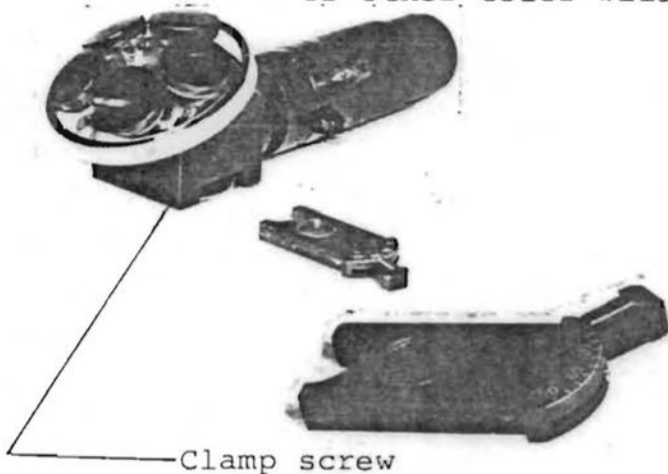
- (3) Use of field diaphragm

The field diaphragm can be effectively used in obtaining a sharp image by cutting off harmful stray light outside the field of view.

Turn the field diaphragm knob "F" downward and the dark image of the field diaphragm will appear in the field of view. Extend this image little by little and stop at a position slightly off the field of view.

Sensitive tint plate (special accessory)

This is used for detecting and observing double refracting substances with increased contrast in observation by polarized light. The plate is a colorless, transparent crystal thin plate and produces a beautiful purple color when observed in polarized light. If there is the slightest retardation in the specimen, blue, orange or other color will appear instead of purple.



The sensitive tint plate is used in place of the analyzer frame by loosening the clamp screw on the front of the carrier and insert the plate and fix it. In the following figure, pushing the lever causes the plate to be inserted and when it is pulled out, it can be used as an analyzer.

o Parfocal adjustment of objective

All the objective mounted in the UNIMET have been subjected to rigorous parfocal adjustment from low magnification to high magnification. When the magnification of the objective is changed, focussing can be accomplished by manipulating the fine focus control alone.

o Care to be taken in using an objective of high magnification

In using a higher power objective, it sometimes happens that the tip of the objective sweep the specimen surface or the lower side of the stage plate. This does not give a favorable effect to both the specimen and objective.

To avoid this, keep the following precaution in mind.

- . Start with a lower power objective of 10x or so and change over to higher magnification even when a higher power objective lens is to be used.
- . If 40x or 80x objective lens is used frequently, change the objective after raising the stage slightly by means of the coarse focus control knob and then lower the stage slowly. When the image comes into view, stop the coarse focus control knob and carry out precise focussing by means of the fine focus control knob. Once you get used to it, it can be done easily and simply.
- . Use a stage plate with as large a center hole as possible. If a stage plate with a small hole has to be used because of the small size of the specimen, the stage movement will be limited in X and Y directions. So be careful in stage movement.

G. Filter

In any of the lamphouse of the Unimet MR1, MR2 and MR4 are contained two filters of green and blue. Besides these, one spare slot is provided, into which a spare filter (available at extra cost) can be fitted. Of these, the green filter is used in normal visual observation. This should serve to enhance contrast and reduce strains on eyes.

Note: For the use of the filter in photography, refer to page of this manual.

VIII. PHOTOGRAPHY (MR1, MR2)

A. Photography

(1) MR1 and MR2

Model MR1 and MR2 Unimet is provided with a "Photo-box" unit in the microscope body to allow 35 mm photography and large size film photography.

Film size	Film used	Lens	Film holder	Actual picture size
35 mm	All 35 mm roll films	3.3x		24.5 x 36 mm
3" x 4"	All 3" x 4" sheet films	10x 12.5x	Special holder for 3" x 4" film sheet film holder	77 x 100 mm
4" x 5" V	All 4" x 5" sheet films	15x (with scale) 20x	Special holder* for 4" x 5" film sheet film holder	95 x 120 mm
3" x 4" Polaroid	Polaroid film 107, 108, 109	5 films on a turret	#405 holder*	73 x 95 mm
4" x 5" Polaroid	Polaroid film 52, 55, 57, 58		#545 holder*	89 x 114 mm

(* The film holder is a special accessory.)

By pushing the button "shutter" on the exposure meter, the self-contained electromagnetic shutter is operated.

(Note)

Any 4 x 5 sheet film holder of the international standard can be used, but it is recommended to use the Union sheet film holder specially designed for photo-micrography. The outside dimensions of the 3 x 4 sheet film holder are exactly the same as those of the 4 x 5 film holder.

(2) MR4

The following special accessories are available for photography by MR4.

Film size	Film used	Lens	Camera body shutter	Film holder
35 mm	All 35 mm roll films	4x (included in the attachment)	Single lens reflex camera B.1 - 1/500 sec. FUJICA ST	
3" x 4" Polaroid	Polaroid film 107, 108, 105	10x (included in the attachment)		#405 holder

B. 35 mm film

(For 35 mm photography by MR4, refer to the paragraph on the special accessories to be mentioned in the latter part.)

Prior to photography, make the following preparations.

- o Exchange the scale reticle mounted on the objective lens with the accessory finder reticle (mounted in frame).

- o Load film in the camera. Refer to the instruction manual of the camera body.

- o MR1 is provided with the automatic exposure control AE-1, and MR2 is provided with the semi-automatic exposure control EM-2. Carefully read their respective instructions given in the latter part.

(1) Adjustment of diopter

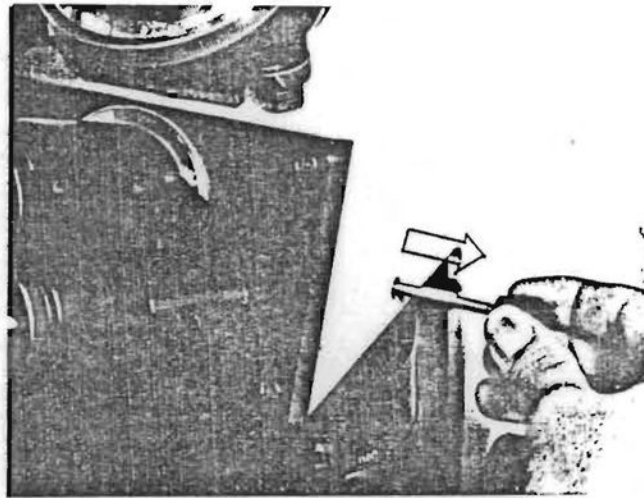
Adjust the diopter of the finder reticle.
(See page .)

(2) Focussing

Looking through the eyepieces, carry out focussing of the specimen.

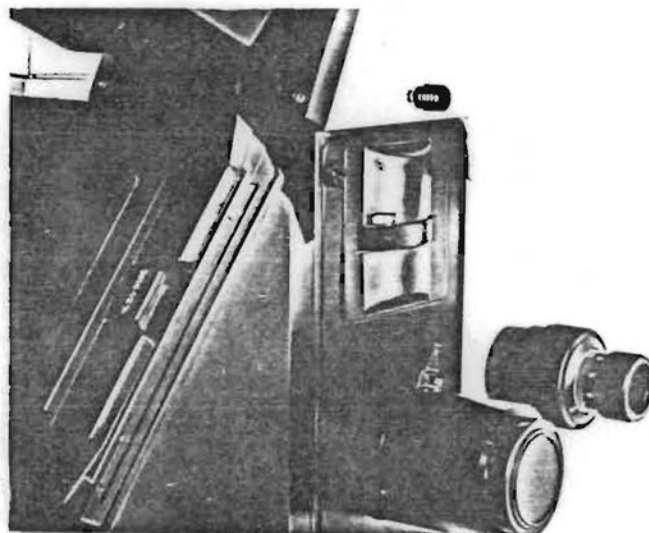
(3) Change over the optical path to photography

Pull out the lever on the right side of the body frame, and the optical path can be changed over to photography.



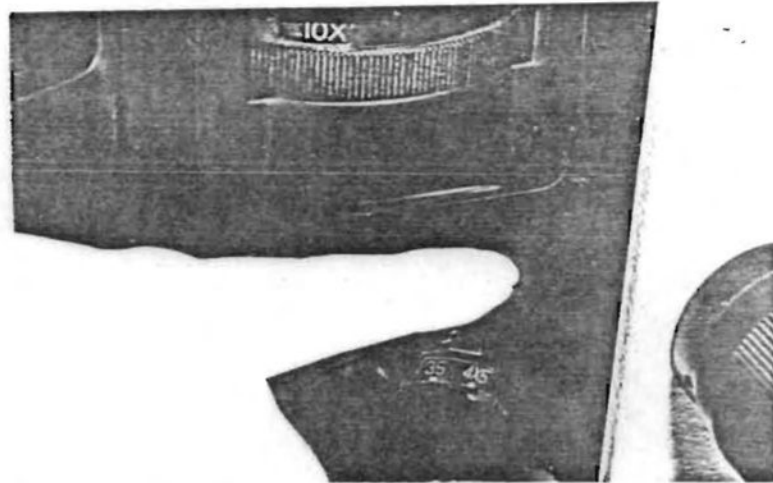
(4) Mount the 3.3x photo-eyepiece

Five photo-eyepieces are loaded on the turret housed in the photo unit board. In 35 mm photography, 3.3x lens is exclusively used.



- (5) Set the camera selection lever to 35 mm.

Set the camera selection lever on the 35 mm camera fitting tube to "35".



This completes the preparation for photography. All you do is take a photograph in accordance with the instructions on the use of the automatic exposure control or semi-automatic exposure control.

Note:

- (1) Film take-up knob:
For take-up of the film, use the knob of the camera body. Take up the film slowly and securely until the knob stops. During the take-up the rotation will give slight resistance but this is not a failure.
- (2) Adjustment of diopter:
Adjust the diopter of binocular head accurately because the diopter of human eyes is always changing. Note that the sharpness of a 35 mm photograph depends on the adjustment of diopter.

C. Large size film photography (3" x 4", 4" x 5" sheet films)

(3" x 4" film holder is a special accessory.)

Photographing procedure

- (1) Selection of optical path

Changeover method of the optical path from the observation side to the 3" x 4" or 4" x 5" photography side is the same as for the 35 mm film.

(2) Selection of photographic eyepiece

Select and set an eyepiece of any magnification (10x x 12.5x, 15x or 20x), except 3.3x for exclusive use in 35 mm photography).

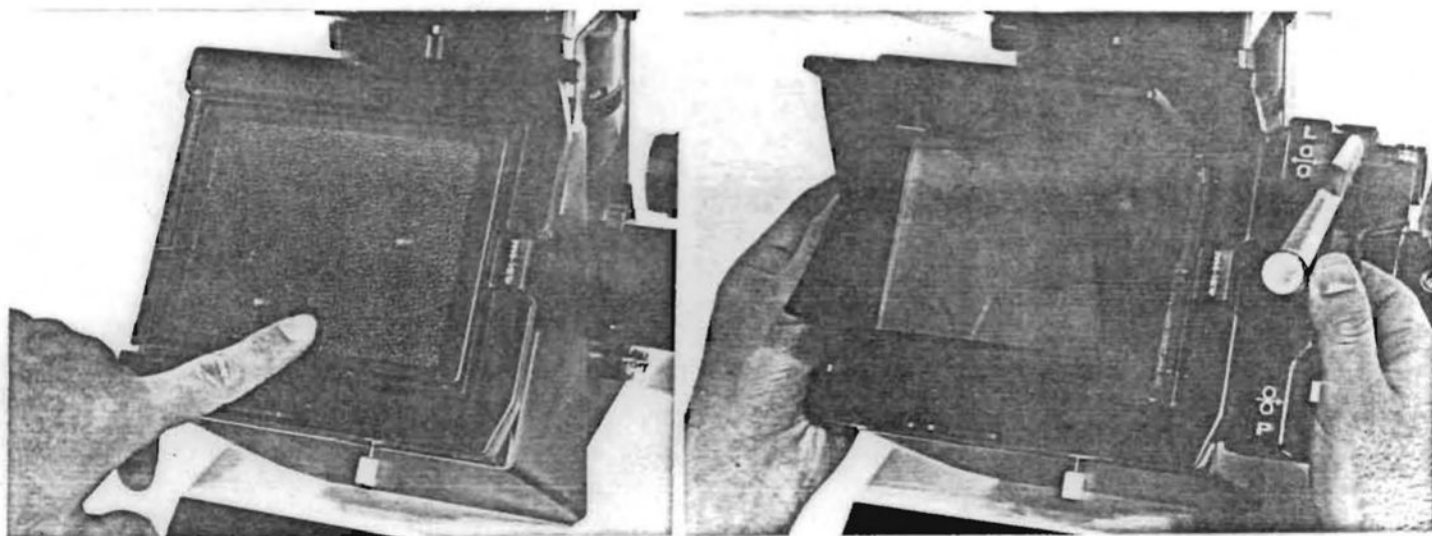
(3) Focussing

For focussing in photography with large size film, use the focussing screen which is an attachment of the universal photographic contrivance for large size films. The hood for the focussing screen is designed in a hold type and can be opened and closed by button operation on the exposure controller. This focussing screen can be very conveniently used as a large screen in observation.

To project the image onto the focussing screen, open the self-contained electromagnetic shutter. Press the OPEN button (shutter) of the automatic exposure controller or semi-automatic exposure controller.

(4) Determination of picture frame

The focussing screen has some markers corresponding to the film size. So determine the picture frame according to the film to be used.



Open/close button

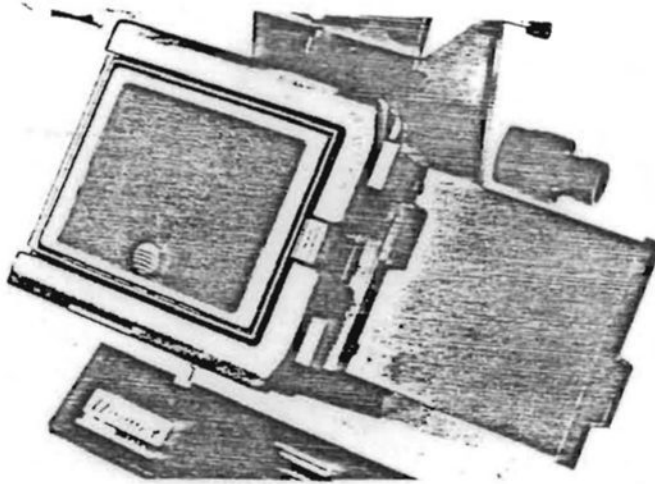
(5) Insertion of film holder

Slowly insert the film holder in which film has been loaded, from right with the hood slightly floated.

This completes the preparation for photography. Take a photograph in accordance with the procedure for the exposure controller.

(6) Pulling out the sliding cover of the film holder

Gently pull out the sliding cover of the film holder. Here, do not pull the cover all the way but leaving approximately 15 mm in the film holder.



(7) Removal of film holder

Insert the sliding cover in the original position of the film holder and pull it out slightly floated. Put a mark on the film holder containing an exposed film so that it will not double exposed. Photographs can be taken on both sides of a film.

For the method of loading 3 x 4 and 4 x 5 sheet film and handling of the holder, refer to separate paragraph.

D. Union 3 x 4 and 4 x 5 sheet film holders

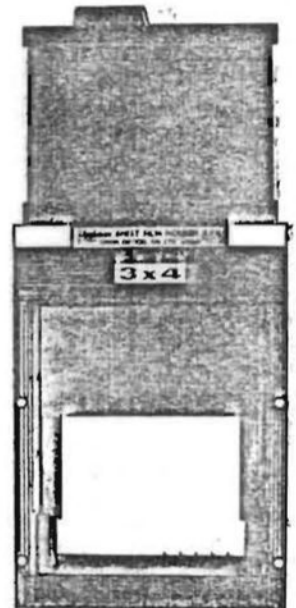
These film holders are designed for photomicrography using sheet films. It features complete light shielding property and excellent durability and is provided with five triangular markers to be put on the film for identification, which is indispensable in photomicrography. Both types of holder are the same in the outside dimensions and are manufactured in conformity with the international standard. So it can be used in any microscope provided with a camera back of the international standard.

o Identifying marker

The 3 x 4 and 4 x 5 sheet film markers have small triangular protrusions (markers) on the film keep plate as shown in the figure. This marker is put in the corner of the film frame. The material of the keep plate being ABS resin, it can be scraped off with a sharp knife edge.

By combining five markers, 32 different identifying marks can be used as shown in the figure below. Choose an appropriate combination from them and put it on each film holder.

When a mark is decided, put an Arabic numeral on the right shoulder of the holder so as to identify the number of the mark in the combination. A table showing the correspondence between the mark and Arabic numeral (this will be the individual number of the holder) will be conveniently used for reference.

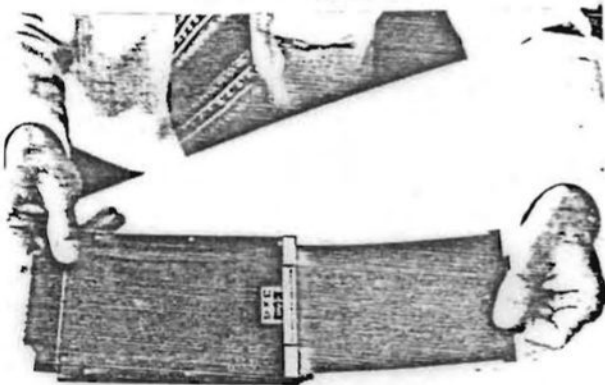


[Example of combination]

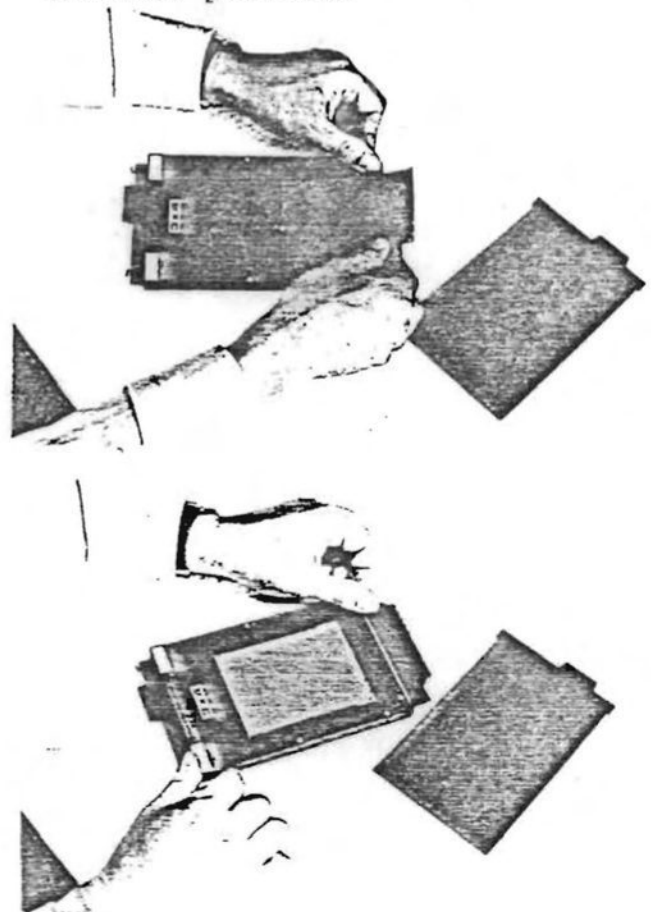
1	▲	17	▲
2	▲	18	▲
3	▲	19	▲
4	▲	20	▲
5	▲	21	▲
6	▲	22	▲
7	▲	23	▲
8	▲	24	▲
9	▲	25	▲
10	▲	26	▲
11	▲	27	▲
12	▲	28	▲
13	▲	29	▲
14	▲	30	▲
15	▲	31	▲
16	▲	32	▲

o Loading the film holder (load it in a photographic dark-room)

- (1) Pull out the sliding cover of the film holder, raise the film keep plate and hold it with fingers.

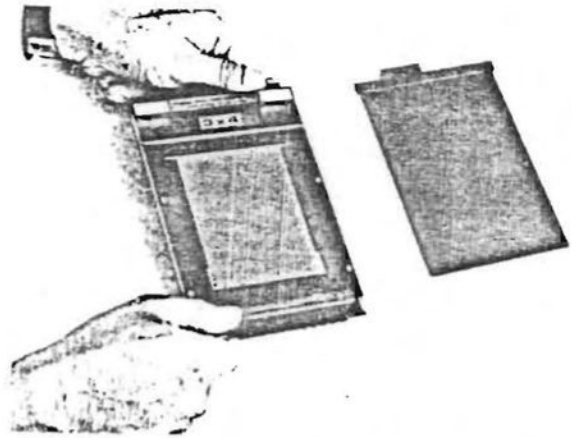


- (2) Hold the film, with the notch in the upper right, keep the end of the film in parallel to the end of the holder and insert the film slowly through the notched portion.



- (3) If the film is loaded in an unsatisfactory condition, the end of the film will be in the position as shown in the figure. So check it with fingers.

- (4) Throw down the film keep plate in its original position and insert the sliding cover.
- (5) To prevent the sliding cover from coming out by chance, fasten the hook.



o Unloading the film (unload it in a photographic darkroom)

- (1) Pull out the sliding cover and raise the film keep plate.



- (2) With the nail in the elliptic cutoff portion, pull the film upward as if scooping it up and then draw it out sliding, holding the film end with fingers.

o Care in film handling

- . Prior to loading the sheet film in the holder, make sure of the above procedure using unnecessary film in the light.
- . Be careful not to touch the film emulsion except for the edge. Special care is necessary in a rainy season or in a hot and humid place.
- . In handling the film, use of photographic gloves is recommended.

E. Polaroid film

(The Polaroid film holder is a special accessory.)

The Polaroid film that gives the photographed result quickly is also very useful in photomicrography. The universal photographic contrivance of the UNIMET accepts the Polaroid film holder and can be used conveniently.

The Polaroid films and holders that can be used in the UNIMET are shown below.

3 x 4 film holder	Film (actual picture size 73 x 95 mm)
#405	<p>105 - ASA50, monochromatic film that can be used for both negative and positive.</p> <p>Type 107 - ASA3000, high sensitivity monochromatic film</p> <p>108 - ASA75, film for color print</p>
4 x 5 film holder	Film (actual picture size 89 x 114 mm)
#545	<p>52 - ASA400, medium sensitivity monochromatic film</p> <p>Type 55 - ASA50, same as type 105</p> <p>57 - ASA3000, same as type 107</p> <p>58 - ASA75, same as type 108</p>

o Operating procedure when #405 film holder is used

- (1) Load a film to be used in the film holder in accordance with the instructions attached to the Polaroid film.
- (2) Focus an image of the specimen on the screen.
- (3) Remove the cover from the holder.

Holding the screen hood with the right hand, pull the sliding cover to left with the left hand and stop it where a red line comes in sight.

- (4) Actuate the shutter.

Actuate the shutter by means of the exposure controller.

- (5) Return the sliding cover in the original position.

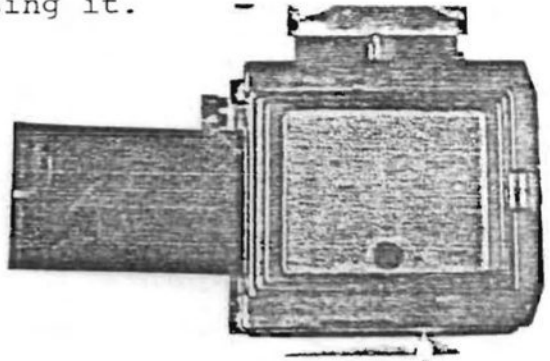
Insert the sliding cover in the original position.

- (6) Unload the film for development.

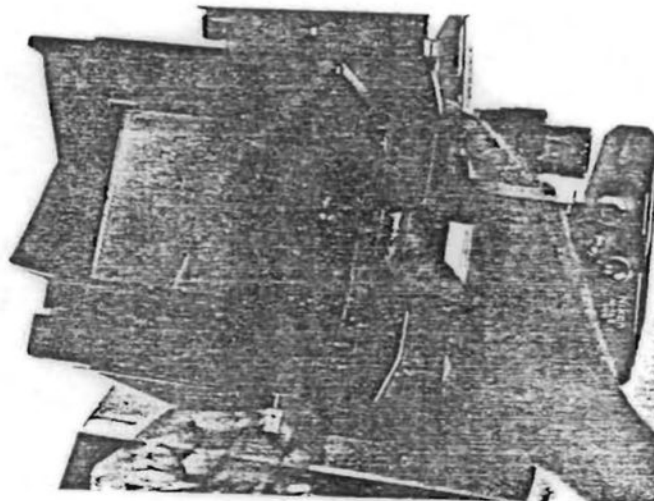
For the development processing, see the instructions attached to the film. Take out the film holder from the microscope slightly raising it.

- (7) Proceed to the preparation for the next photography.

Repeat the procedures in par. (2) and succeeding paragraphs.



- o In the universal photographic contrivance with the large size photo-mechanism, the center of the (4 x 5") picture and the center of the (3 x 4") picture of the Polaroid #405 back do not coincide because of the mechanism of the Polaroid back. To correct this, loosen the clamp screw in the lower part of the universal photographic contrivance, as shown in the figure, and insert the Polaroid back when it has moved to left. This operation is necessary only when the (3 x 4") Polaroid film holder #405 is used and is not necessary in using other film holders.



Note:

- o For the development processing of the Polaroid film, carefully read the instructions attached to the film.
- o The sliding cover of the #405 film holder is heavier than the 3 x 4 and 4 x 5 sheet film holders. So in operating the holder, hold the microscope hood so that the holder does not move.
- o Operating procedure when #545 film holder is used
 - (1) Observe an image on the screen.
 - (2) Focus the image of the specimen.
 - (3) Insert the film holder.

Insert the film holder in which film is loaded, slowly from the right with the hood slightly floating.
 - (4) Pull out the outer case of the film packet.

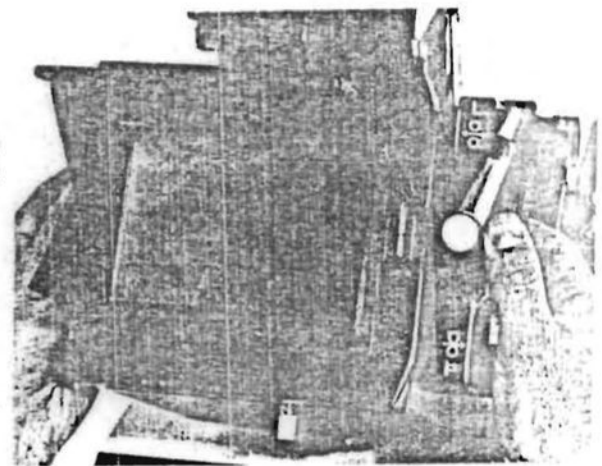
Pull the outer case of the film packet to right until it stops.
(But do not pull it out.)
 - (5) Actuate the shutter.

Actuate the shutter by means of the exposure controller.
 - (6) Return the outer case of the film packet.

Insert the outer case of the film packet in the original position.
 - (7) Take out the film holder.

Take out the film holder, slightly floating, from the microscope.
 - (8) Take out the film for development.

Take out the film and process it for development in accordance with the film instructions.



IX. USE OF AE-1 AUTOMATIC EXPOSURE CONTROLLER

The instrument is designed for an operator who has never taken a photomicrograph as well as for an experienced operator who wants to take photomicrographs using sophisticated techniques.

A. Specifications of AE-1 automatic exposure controller

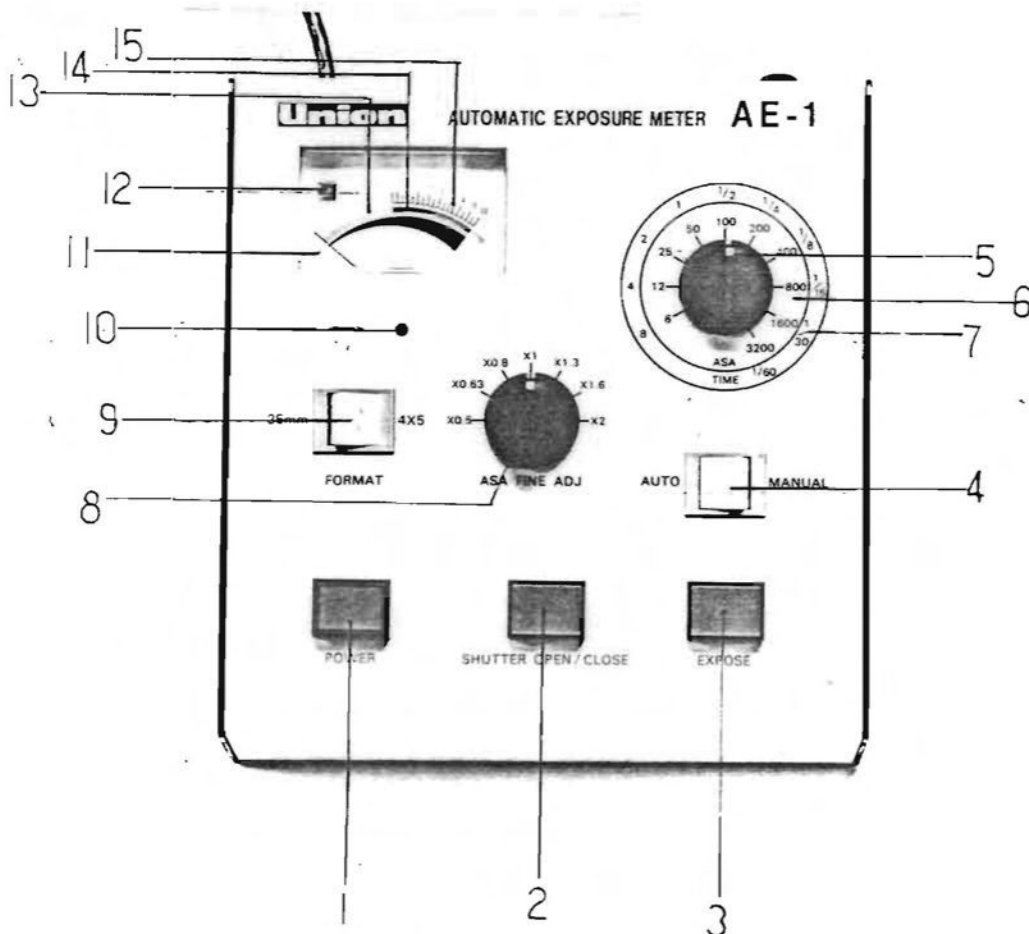
Range of automatic exposure controller	1/60 sec - 30 min
Speed range of film used	ASA6 - 3200 (6, 12, 25, 50, 200, 400, 800, 1600, 3200)
Format of film used	35 mm, 3" x 4" (6 x 7 cm), 4" x 5" (6 x 9 cm)
Fine adjustment range of film speed	0.5x to 2x 7 ranges of 0.5, 0.63, 0.8, 1, 1.3, 1.6 and 2
Shutter	Electromagnetic shutter Actuated by the EXPOSE or SHUTTER OPEN/CLOSE button of the controller
Multi-display meter	Displays on the meter (1) Remaining exposure time (2) Exposure time (3) Out-of-control range
Manual exposure	Selected by selector switch Available from 1/60 sec to 8 sec
Arbitrary open/close of shutter	Can be opened and closed by operation of the SHUTTER OPEN/CLOSE button at any time (used in observation on the screen)
Light receptor element	Silicon photodiode (self-contained in the microscope body)
Power	V AC 50/60 Hz

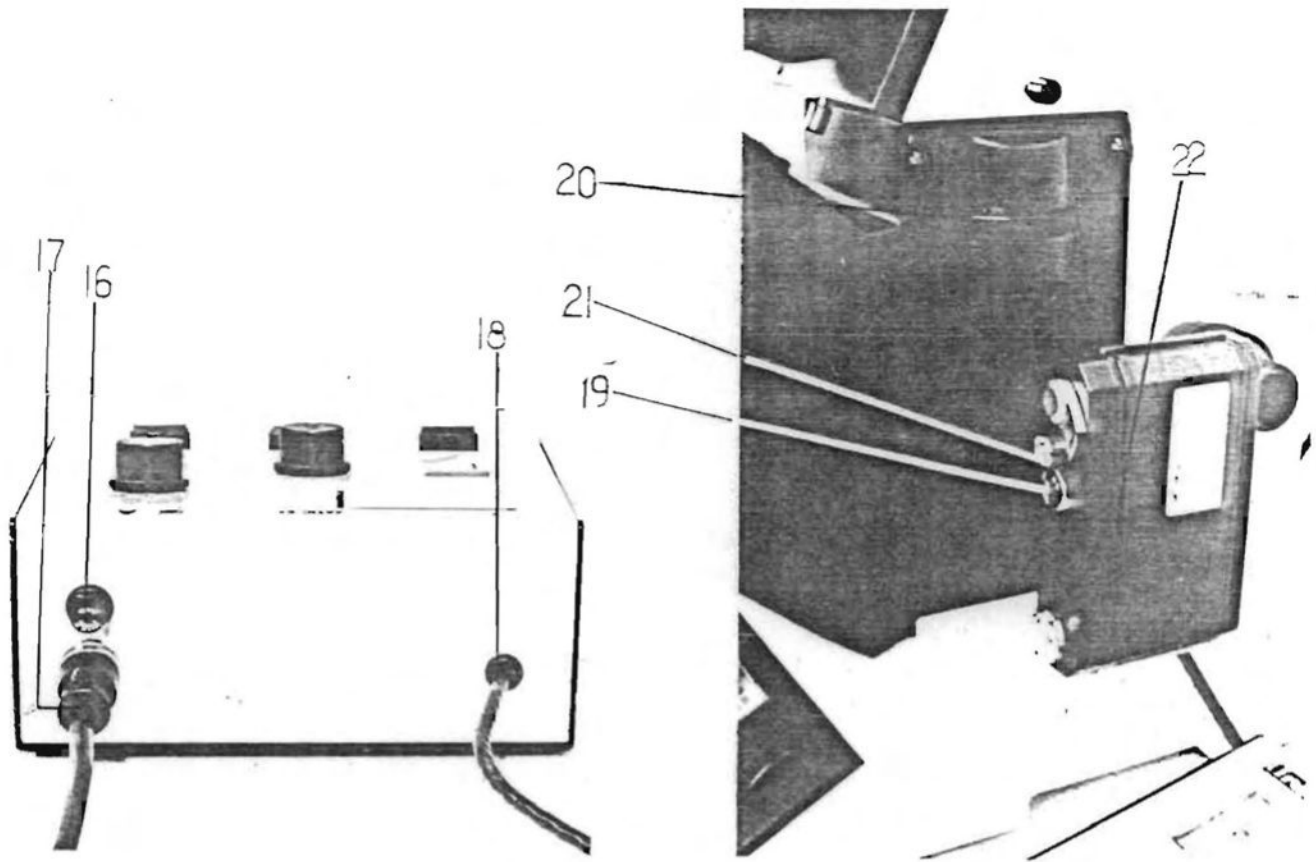
B. Nomenclature and functions

- | | | | | | | | |
|----|--|------------|--|----|--|---|--|
| 12 | Exposure control limit display lamp
Lights up when the quantity of limit is insufficient. | 11 | Multi-display meter | 10 | Zero adjustment screw
For adjustment of the zero point of the meter pointer.
Adjust with the power switched off. | 9 | Film format selector
(Left) 35 mm
(Right) (3x4") |
| 8 | Film sensitivity fine adjustment dial
Permits adjustment in 7 steps within the 0.5x - 2x range. | Controller | | | | | |
| 14 | Exposure time display zone
Scale to indicate the exposure time in real time and displays 1/60 to 30 min within the shutter operating range. | | | | | | |
| 13 | Out-of-control range zone
Red zone to indicate the out-of-control range of shutter | | | | | | |
| 15 | Exposure monitor
The pointer shows the elapse of the exposure time. | | | | | | |
| 5 | Coaxial dial | 6 | Sensitivity setting dial
Dial to set the (ASA) sensitivity of the film to be used. | | | | |
| | | 7 | Exposure time selecting dial
Dial for selecting time in manual exposure
Equally graduated multiple scale of 8 sec to 1/60 sec | | | | |
| | | 4 | Mode selector
Selector switch to select the automatic exposure mode and manual exposure mode | | | | |
| | | 3 | Exposure button
Release button for automatic exposure.
The green lamp is on when the shutter is in operation. | | | | |
| | | 2 | Shutter open/close switch
Switch for arbitrary open/close of the electromagnetic shutter
The green lamp is on when the shutter in operation. | | | | |
| | | 1 | Power switch
The lamp lights up when power is switched on. | | | | |

- | | | |
|---|---|---|
| 16 Fuse box | 17 Power cord
(primary cord
V AC) | 18 Extractable cord
to be connected
to the microscope
body |
| 20 Photographic eyepiece turret
Eyepieces for 35 mm (3.3x)
and large size film (10x,
12.5x, 15x, 20x) on 5-piece
turret | 19 Socket for the retractable cord
of the AE-1 | Dark box camera for
exclusive use |
| 21 Camera selection lever
Selection lever for 35 mm and large size films | | |
| 22 Dark box camera for exclusive use | | |

Photo unit board





C. Installation of AE-1

1. Connection of cord

- (1) Connect the plug of cord (18) to the socket (A) located on the photo unit board of the microscope body and connect the accessory AC power cord (17) to the electric power source and press the power switch (1) of the controller. Here, check that the red lamp lights up.

2. Installation of controller

(1) Setting of film sensitivity

Set the ASA value which is the nominal sensitivity of the film on the sensitivity indexes by means of the coaxial dial (5).

(If there is no suitable scale for the sensitivity value of the film to be used, refer to par. 5.)

(2) Selection of mode

Select either the automatic exposure or manual exposure mode by means of mode selector (4). AUTO is for automatic exposure. Here, select AUTO.

(3) Setting of the film sensitivity fine adjustment dial

Normally, set the dial (8) to the x 1 scale. For detailed operating procedure of each part, refer to par. 5 and the flowchart of the photography procedure.

(4) Setting of film size

In the case of 35 mm film, throw the film format selector (9) to left and in the case of the 3" x 4" or 4" x 5" large size film, throw it to right.

D. Photography by automatic exposure

(1) Photography by 4" x 5" or 3" x 4" film

- (1) Set the film size selector (9) of the controller to 4 x 5.
- (2) Set the camera selector lever to (4 x 5).
- (3) Press the shutter open/close switch (2) of the controller. An image will be seen on the screen. Here, check the following.
 - . When the image is shaded on the screen;
See if the photo-eyepiece is 3.3x for exclusive use with 35 mm film.
 - . No image in sight;
See if the optical path selector lever and the camera selector lever are in the correct position.
 - . When the image is dark;
Check the illumination and also check if the analyzer or polarizer is in the optical path.
- (4) Focus a sharp image of the specimen by means of the fine focus control and determine the picture frame.
- (5) Press the shutter open/close switch (2) to close the shutter.
- (6) Load the film holder and pull out the sliding cover.
- (7) Press the exposure button (3), and automatic exposure is carried out. While exposure is being done (while the shutter is opened), the lamp of button (3) is on.

- (8) Insert the sliding cover of the film holder in the original position and take out the holder.
Repeat the procedures starting with par. (1).

Note:

Before switching off the power of the controller, be sure to check the shutter open/close switch (2) is closed.

If the power switch (1) is turned off with the shutter opened, the shutter will remain closed when the switch (1) is turned on next time while the lamp of the shutter open/close switch is on. Should this happen, immediately press the shutter open/close switch (2) to close the shutter and press it for a second time after three seconds to close the shutter. The normal condition will be restored.

If the shutter open/close switch (2) and exposure button (3) are operated repetitively, operate them at intervals of three seconds or more. If they are operated at intervals shorter than this, the shutter may not be controlled accurately by second.

- (2) 35 mm film photography

- (1) Set the film size selector (9) of the controller to 35 mm.
- (2) Set the magnification of the photo-eyepiece turret to 3.3x.
- (3) Focus the specimen image and determine the frame in accordance with the finder reticle of the eyepiece. In the case of the 35 mm film, a sharp photograph cannot be obtained if the reticle is not focussed accurately because the reticle position of the eyepiece and film surface are parfocal.
- (4) Change over the optical selection lever to the photography side.
- (5) After making sure that the shutter open/close switch (2) of the controller is not on, pull out the douser of the camera body.
- (6) Press the exposure button (3) of the controller. With completion of the exposure, the lamp of the button goes off.

- (7) With completion of exposure, take up the film by one frame.

Note:

To interrupt automatic exposure: To interrupt exposure due to a too long exposure time, either switch off the power or change over the mode selector (4) to MANUAL.

In interruption by the mode selector (from Auto to Manual), the manual function operates the moment the selector is changed over and the shutter is closed after the displayed time of the exposure time display zone (B) marked as "TIME" on the controller has passed.

(Example: When ASA100 is set, the shutter is closed after 1/2 second has passed.)

E. Manual photography

The AE-1 controller permits exposure in steps of multiple at equal intervals from 8 sec to 1/60 sec. It is used when determining exposure at one's discretion without using the automatic exposure or when it is necessary to change the exposure level intentionally.

- (1) Set the mode selector (4) of the controller to "MANUAL".
- (2) Set the coaxial dial to the time indicated in the exposure time display zone (13). (unit: sec)
- (3) Press the exposure button (3).

Exposure is performed for the selected time.

Note:

- o For exposure in excess of 8 sec, use the shutter open/close switch (2). Press the button, measure time by a watch and press the button again after elapse of the required exposure time.
- o With the mode selector (4) set to "MANUAL", all functions related to automatic exposure stop. Operation is performed according to the time set by the MANUAL irrespective of the position where the sensitivity setting and film size selector, and film sensitivity fine adjustment dials are positioned.
- o The photography procedure is almost the same as in automatic exposure for both the 35 mm and 4" x 5" films, except the setting for automatic exposure.

F. Use of film sensitivity fine adjustment dial

The AE-1 is provided with film sensitivity fine adjustment dial (8), which can be varied in units of EV. The following adjustment can be made using this dial.

Three functions of the film sensitivity fine adjustment dial:

- (1) Arbitrary control of over- or underexposure
- (2) Setting of the film sensitivity (ASA) outside the dial setting
- (3) Can be used in correcting the reciprocity law failure

The fine adjustment variable range of this dial is ± 1 step each ($2/3$ EV), and the film sensitivity and exposure time change as follows.

Change in exposure time	UNDER			OPTIMUM		OVER	
	-1EV	-2/3EV	-1/3EV	0	+1/3EV	+2/3EV	+1EV
Change in exposure amount	5 sec.	6.3 sec.	8 sec.	10 sec.	13 sec.	16 sec.	20 sec.
Change in film sensitivity	200	160	130	100	80	63	50
Correction value	0.5	0.63	0.8	1.0 times	1.3	1.6	2

Note:

The table shows changes in the film sensitivity, using ASA-100 as a reference, where changes in the exposure time show the values when exposure is made for 10 sec with ASA-100 and EV 0.

- (1) Adjustment of over- and underexposure

Suppose an ASA-100 filter is used and the exposure condition at that time is 10 sec in the foregoing table. (Check the exposure time in the exposure time display zone of the multi-display meter to be mentioned in the latter part.)

To make slightly over- or underexposure, desired exposure can be made by setting the correction value of the film

sensitivity fine adjustment dial to a desired multiple value.

(2) Setting of film sensitivity (ASA) outside the dial setting

The sensitivity setting dial (6) of the AE-1 is graduated with a scale from ASA6 to 3200, which covers the range of most commercial films.

This fine adjustment dial permits selection of sensitivity over a wide range of ASA3 to 6400 as shown below.

Sensitivity selecting range by film sensitivity fine adjustment

Film sensitivity Correction value	6	12	25	50	100	200	400	800	1600	3200
0.5	3	6	12.5	25	50	100	200	400	800	1600
0.63	4	8	16	32	64	128	256	512	1025	2050
0.8	5	10	20	40	80	160	320	640	1280	2560
1	6	12	25	50	100	200	400	800	1600	3200
1.3	8	16	32	65	130	260	520	1040	2080	4160
1.6	10	22	45	90	180	360	720	1440	2400	5760
2	12	24	50	100	200	400	800	1600	3200	6400

The following correction can be made by this.

[Example 1] To select (ASA-125), set the sensitivity selection dial of the coaxial dial to ASA200 and the film sensitivity fine adjustment dial to $E \times 0.63$. We obtain ($200 \times 0.63 = 126 \div 125$) or when the selector is set to ASA100 and the fine adjustment dial is set to $x1.3$, we obtain ($100 \times 1.3 = 130$). In any case, the value is close to ASA125.

[Example 2] When an ASA100 film is used as an ASA64 film: This action is intentionally taken to obtain an overexposed negative film. Set the sensitivity selecting dial to ASA100 and the film sensitivity fine adjustment dial to 0.63, and the intended sensitivity can be obtained. (The same result can be obtained by setting ASA value and the correction value as 50 - $x1.3$.)

- (3) For correction of reciprocity law failure, refer to par. 7 to be mentioned in the latter part.

G. Multi-display meter

The multi-display meter of the AE-1 controller has a variety of functions as shown below.

- (1) Real-time display of exposure time -- (exposure time display zone)

This displays the actual exposure time in photography. Since it is possible to know the exposure time in advance, correction of reciprocity law failure (to be mentioned in par. 8) can be checked in advance.

- (2) Checking the elapse of exposure time -- (remaining exposure time indicator)

With the start of automatic exposure, the pointer moves from right to left. This shows the elapse of the exposure time from the beginning to the end and can be conveniently used in long exposure, when the operator may wish to know the remaining exposure time.

- (3) Display of the range in which automatic exposure can be controlled -- (zone outside the controllable range)

This tells whether the quantity of light is appropriate or not in automatic exposure. When the quantity of light is excessive or insufficient, the pointer comes in the red zone on the meter scale. When the pointer is in the green zone, the quantity of light is in an optimum exposure range. When the pointer is in the red zone, make adjustment so that it comes in the green zone by means of the diaphragm, filter, etc.

- (4) Display of exposure controllable limit

The automatic exposure control has a limit in which a long exposure can be controlled for a small quantity of light, depending on the film sensitivity (sensitivity limit with respect to a small quantity of light). The AE-1 has the following limit values. With an ASA3200 film, control over two minutes is not possible even if the pointer is in the green zone. This lamp lights up and displays the limit in such a case.

Limit values in long exposure for AE-1

35 m/m			Limit values	Large size film	Limit values
ASA	6		4 min.	ASA	6
"	12		2 "	"	12
"	25		1 "	"	25
"	50		30 sec	"	50
"	100		15 "	"	100
"	200		8 "	"	200
"	400		4 "	"	400
"	800		2 "	"	800
"	1600		1 "	"	1600
"	3200		1/2 "	"	3200
					30 min.
					30 "
					30 "
					15 "
					8 "
					4 "
					2 "
					1 "
					30 sec
					15 "

Note:

- o The exposure time (exposure time display zone) displayed on the multi-display meter shows a guide. There may be a discrepancy between the time indicated by the pointer and actual exposure time, but this does not affect the automatic exposure photography in any way.
- o This meter operates only when the exposure mode selector is set to automatic exposure (AUTO).
- o Pressing the shutter open/close button causes the meter pointer to deflect to left once and then to return to the original position, but this is not a trouble in function.

H. Reciprocity law failure and its correction

(1) What is a reciprocity law failure?

The photographic film is characterized by reciprocity law failure. When the quantity of light that reaches the film becomes half, a negative film of the same density should be obtained if the exposure time is doubled, which means the same quantity of exposure. When this condition holds, we say the reciprocity law holds, but when the quantity of light becomes lower than a certain level, we observe a phenomenon of insufficient exposure on the negative film even if the exposure time is extended.

In other words, in this case, the reciprocity law does not hold. This is termed reciprocity law failure. The reciprocity law is a state that can be balanced by "increasing one when the other decreases" and the

reciprocal law failure is a state that is "out of balance because of failure in compensating for decrease in the other".

When the observed image is dark in photomicrography, for example, by polarized light or darkfield illumination, long exposure time is necessary. Also it is necessary to pay attention to the effect of the reciprocal law failure.

The AE-1 controller is capable of operating the shutter correctly even with a very small quantity of light which ordinary cameras cannot deal with. Thus it operates to make the exposure time double if the quantity of light is half. However, the reciprocal law failure varies with the type of film and it is almost impossible for a controller to cover all reciprocal law failure characteristics.

The result of the reciprocal law failure is the underexposure on the film. (On a color film, it also involves unbalanced coloring.)

This means that a film cannot maintain its nominal sensitivity under very long exposure conditions, making it necessary to correct the exposure time.

(2) Correction of reciprocal law failure

a. Reciprocal law failure calibration curve

In the above case, it is possible to obtain a photograph of standard brightness by correcting the exposure time (by longer exposure). Therefore, if the amount of exposure to be corrected (time) for an exposure time is known, the failure can be corrected.

The following tables show the failure calibration curves for some of representative films. Since these curves can be easily changed by development processing and other factors, they do not apply to all cases. It is therefore recommended to use these curves as criterion to obtain your data by experiment.

o Reciprocal law failure calibration curves

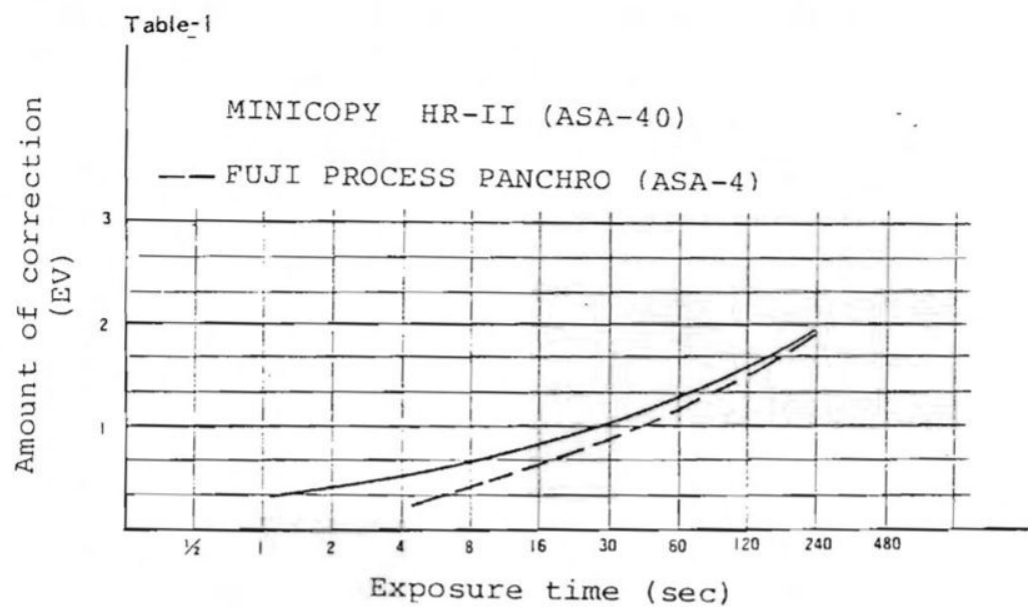
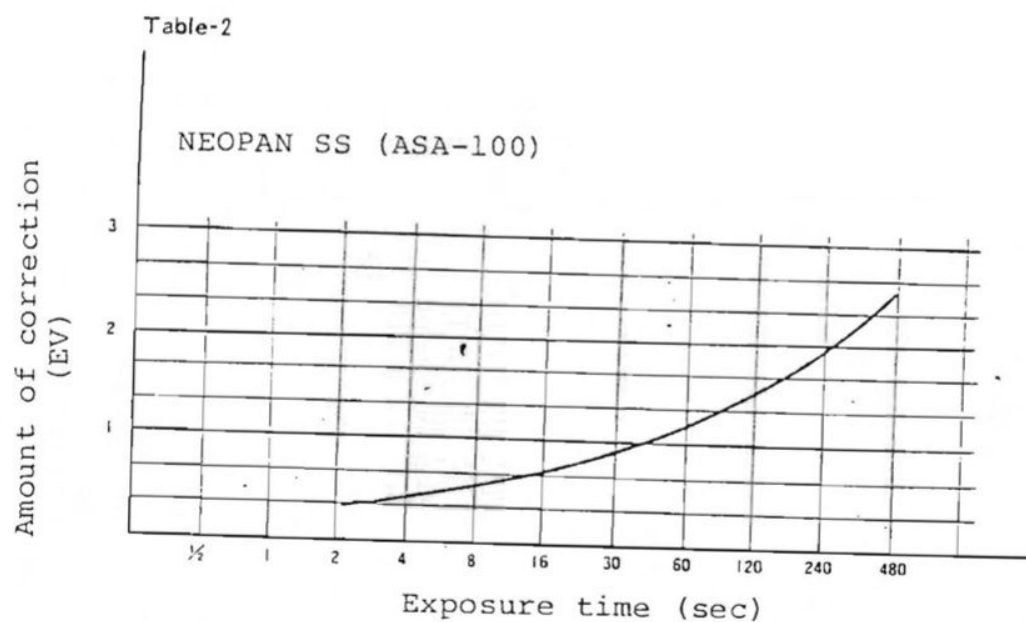


Table-3

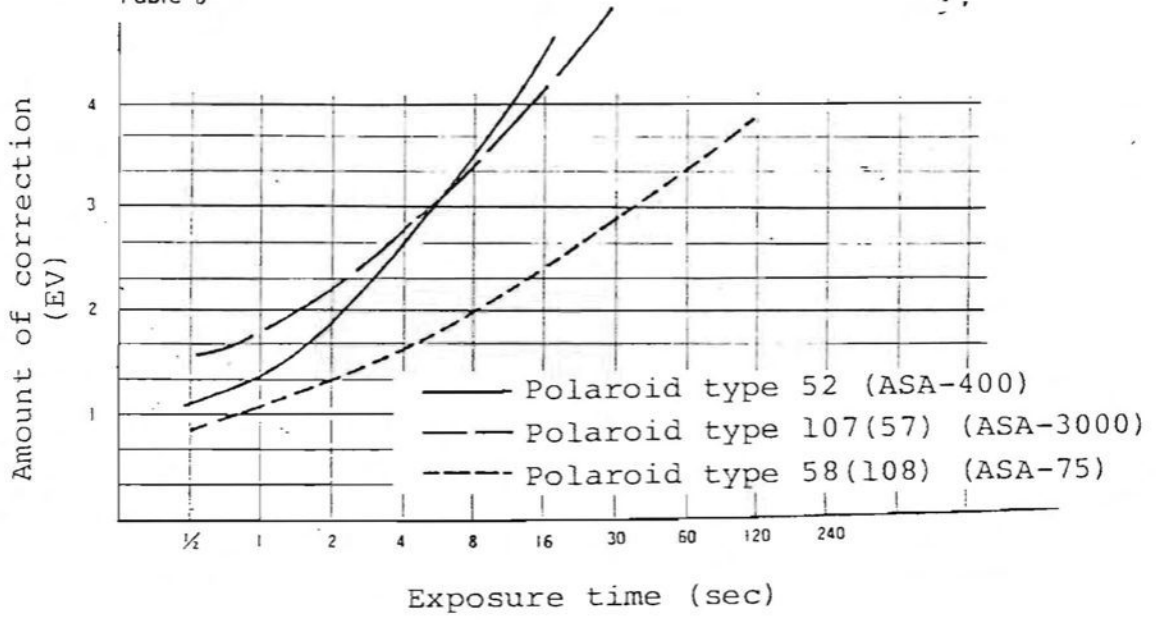
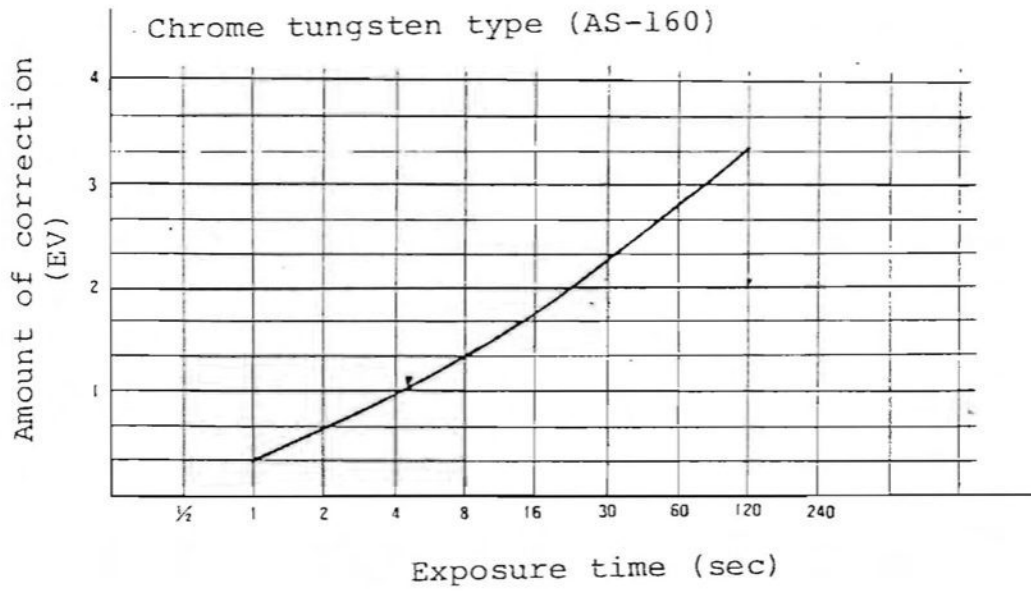


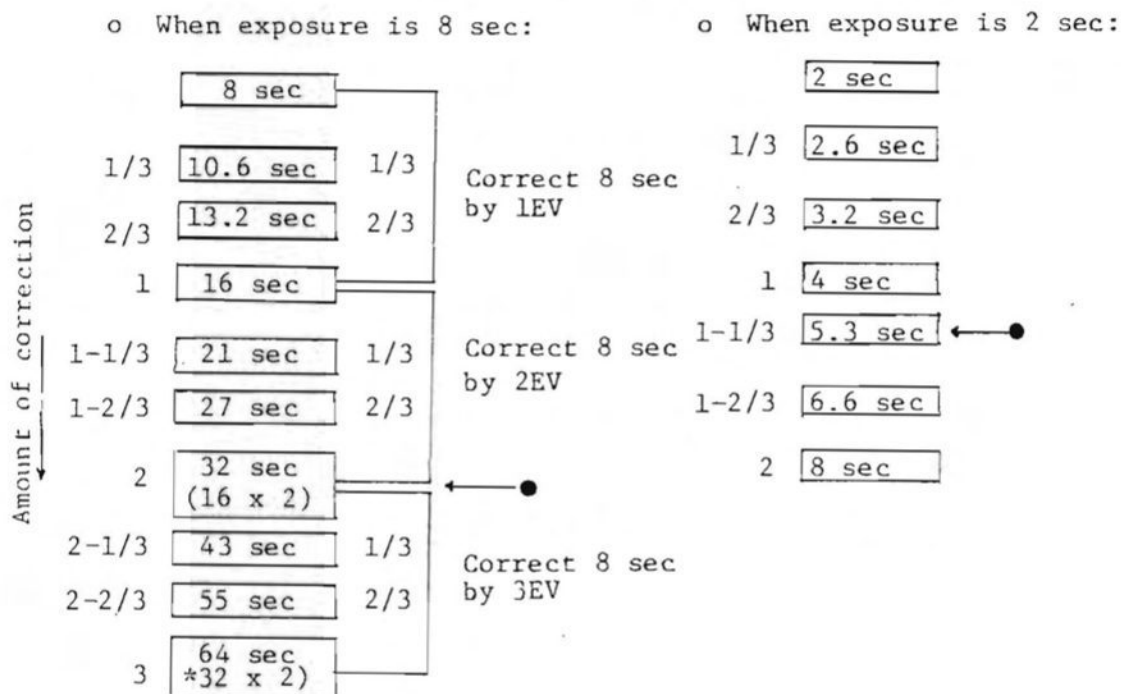
Table-4



b. Correction by film sensitivity

Reference is made to the curve on the preceding page for the film to be used. The X axis shows the exposure time in photography and the Y axis shows the amount of exposure to be corrected (to be added).

The exposure time in photography is indicated on the multi-display meter of the instrument. Let us take the Polaroid type 108 (or 58) color film as an example. If the multi-display meter indicates an exposure time of 8 sec or 2 sec, we can know from the curve that it is necessary to correct the exposure by 2EV when the exposure time is 8 sec and 1-1/3 EV when it is 2 sec.



With the Polaroid type 108 film, excessive underexposure will result if taken under its optimum exposure time of 8 secs and the coloring is not satisfactory either. However, good result can be obtained if the exposure is corrected by the correction value of 2EV. As can be seen from the above figure, if 8 sec is corrected by 2EV, we obtain 32 sec, which is the optimum exposure time. Similarly, the exposure time corrected by 1-1/3 EV for 2 sec will be 5.3 sec (approx. 5 sec). To correct the EV value, the film sensitivity is changed. Keep in mind that 1EV (8 sec - 16 sec) correction corresponds to 1/2 of the film sensitivity (ASA 75+37.5).

Thus 2EV (8 sec + 32 sec) correction corresponds to 1/4 of the film sensitivity (ASA75-18) and you select the film sensitivity of ASA-18. However, the sensitivity selector has not the value of ASA18. So set it to a value nearest to ASA18 by using the film sensitivity fine adjustment dial (par. 6) in conjunction.

This completes the correction of the reciprocal law failure by correction of the film sensitivity. With completion of the setting, press the exposure button.

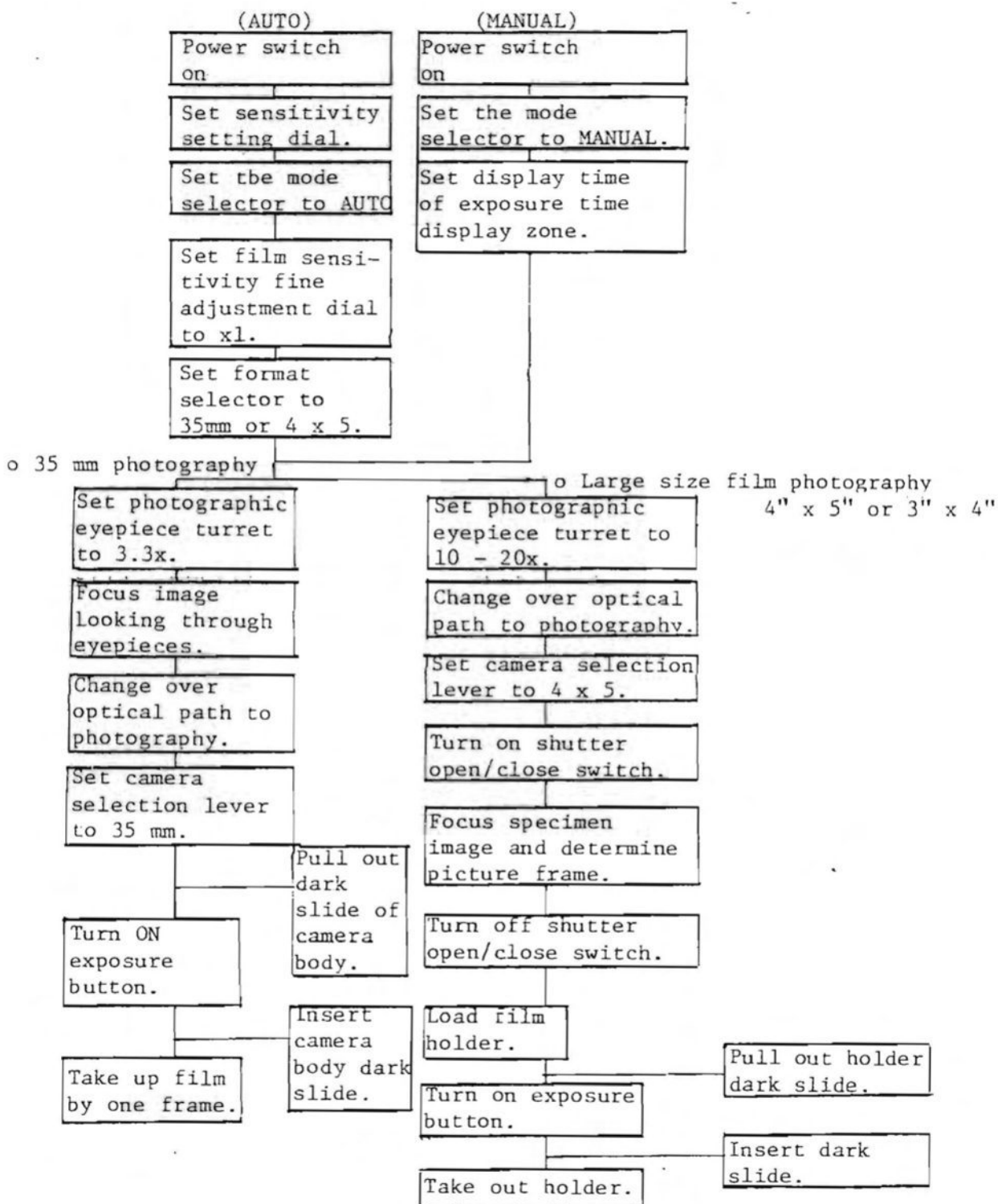
c. Correction by development processing

The intensifying phenomenon of the development processing solution is determined by two factors of processing temperature and processing time. If these two factors are controlled, it is easy to enhance the intrinsic sensitivity of a film by a factor of 2 or 3 without using any special technique.

For example, if the exposure time corrected for the reciprocal law failure is 2 sec and the exposure is made for 1 sec, exposure will be made for only half of the optimum exposure time, in other words, half of the necessary exposure time.

However, with the Polaroid film, it is not possible to make control in the development processing stage and correction must be done by the film sensitivity.

I. Flowchart of photomicrography by AE-1



X. USE OF EM-2 SEMI-AUTOMATIC EXPOSURE CONTROLLER

This instrument is an exposure control unit developed on a new design concept using the most advanced technology. It is an improvement over the conventional direct reading exposure meter with a meter scale and features outstanding operating efficiency.

A. Specifications of the Model EM-2 semi-automatic exposure controller

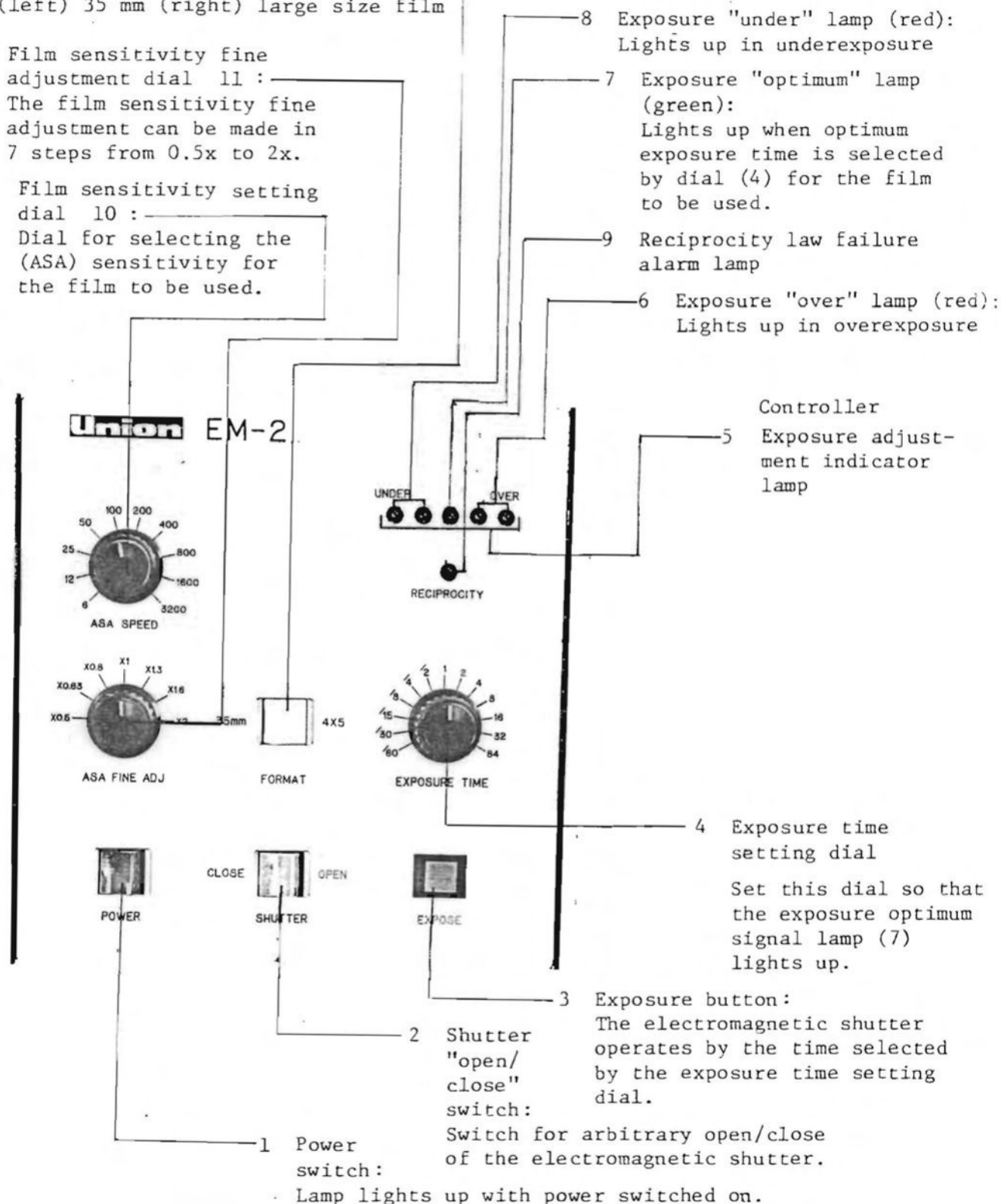
Range of exposure control	Changeover in 13 steps from 1/60 to 64 sec
Speed range of film used	Changeover in 10 steps from ASA6 to 3200 (6, 12, 25, 50, 100, 200, 400, 800, 1600, 3200)
Size of film	35 mm, 3" x 4" (81 x 106 mm), 4" x 5" (100 x 125 mm)
Film speed fine adjustment range	In 7 steps from 0.5x to 2x (0.5, 0.63, 0.8, 1.0, 1.3, 1.6, 2.0)
Shutter	Electromagnetic shutter Operated by EXPOSURE or SHUTTER OPEN/CLOSE button of the controller
Arbitrary open/close of shutter	Can be opened and closed by operation of the SHUTTER OPEN/CLOSE button at any time (used in observation on the screen)
Exposure adjustment display lamp	
. Optimum exposure signal	
. Exposure over signal	
. Exposure under signal	
. Reciprocity	By light emitting diode Lamp lights up in an exposure longer than 1/8 sec
. (Reciprocity law failure alarm)	Alarms reciprocity law failure
Receptor element	Silicon photodiode (self-contained in the microscope body)
Power	V AC 50 or 60 Hz

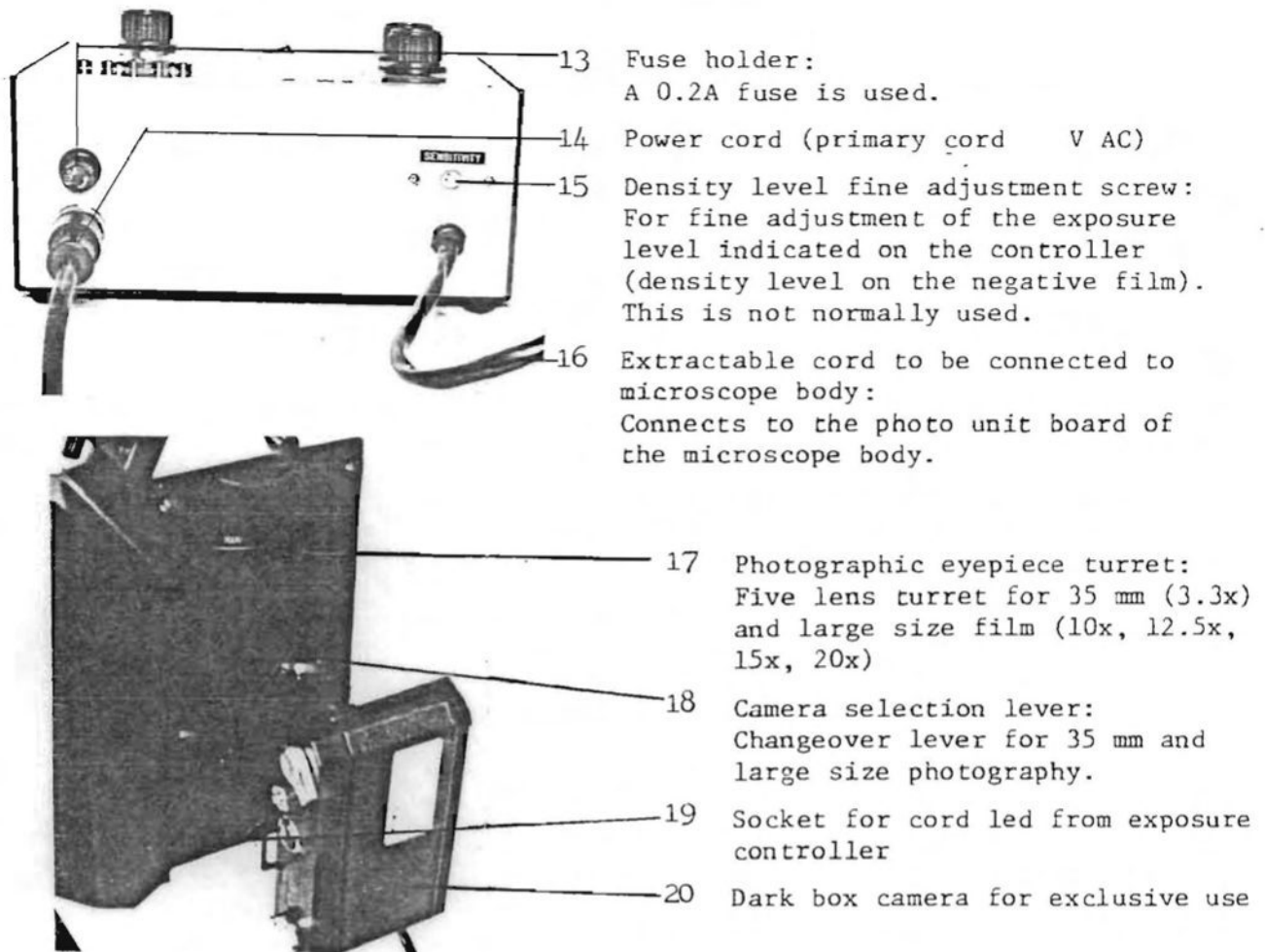
B. Nomenclature and functions

Film format selector 12 :
(left) 35 mm (right) large size film

Film sensitivity fine adjustment dial 11 :
The film sensitivity fine adjustment can be made in 7 steps from 0.5x to 2x.

Film sensitivity setting dial 10 :
Dial for selecting the (ASA) sensitivity for the film to be used.





C. Features of EM-2

(1) No provision of meter

The optimum exposure time can be readily known by dial operation alone. The LED lamp tells you the optimum exposure.

It is no longer necessary to read the meter scale or wait for the pointer to become stable. Also the LED lamp display shows over- and underexposure correctly.

(2) Accurate photometry by the photo-eyepiece system

The optimum exposure can be obtained by using the five photo-eyepieces for 35 mm and large size film provided in the UNIMET.

(3) Provision of a reciprocity law failure alarm lamp

The lamp gives alarm to the operator of the reciprocity law failure of the film before it occurs.

By correction of the exposure time by this lamp, it is possible to make photography free from the effect of a reciprocity law failure.

- (4) Film sensitivity fine adjustment dial can cope with a wide range of film sensitivity

In addition to the sensitivity setting in steps of multiple from ASA6 to 3200 at equal intervals on the standard scale, the film sensitivity fine adjustment mechanism in 7 steps of 0.5x to 2x covers a wide sensitivity range from ASA3 to 6400.

D. Installation of EM-2

(1) Cord connection

- (1) Connect the plug (15) on the rear panel of the EM-2 controller to socket (18) located on the photo unit board of the microscope body and plug the accessory power cord into (13).
- (2) Press the power switch (1) of the controller. Here, make sure the red lamp lights up.

(2) Installation of controller

(1) Selection of film sensitivity

Set the sensitivity (ASA) of the film to be used on the film sensitivity setting dial (10) by matching it to the sensitivity values graduated around the dial. If the film sensitivity value for the film to be used is not on the scale, refer to Section H.

(2) Selection of film size setting

Set the film size selector (12) to 35 mm or 4 x 5 according to the size of the film to be used. In the case of (3-1/4" x 4-1/4") film and Polaroid film, set it to 4 x 5.

(3) Setting of film sensitivity fine adjustment dial

Normally, set the dial (11) to x 1. For details of the operating procedure, refer to Section H.

E. How to know optimum exposure

As mentioned above, the EM-2 controller has no provision of meter. Although it is also of the direct reading type,

it is a semi-automatic exposure controller in which the optimum exposure time is indicated on the lamp and exposure is automatically carried out for an optimum exposure time.

(1) Exposure adjustment indicator lamp

Turn on the power switch (1), and one of the five lamps in the upper right of the controller should light up. If a lamp in the left, with the green lamp in the center, lights up, turn the exposure time setting dial (4) clockwise and if a lamp in the right lights up, turn it counterclockwise slowly. The exposure time (1/60 sec - 64 sec) indicated by the dial when the green lamp in the center lights up is the optimum exposure time. It may happen that a lamp in the right or left jumps over the center green lamp and lights up in the left or right. In this case, read the following note.

Note:

The five LED lamps of the controller have been adjusted to light up corresponding to the change in the quantity of light as shown below.
(expressed in EV values)

- o Exposure optimum lamp (green):
This lamp lights up when the quantity of light changes in a range within 1/3EV to either overexposure or underexposure side with the correct optimum exposure in the center. Changes within this range (strictly speaking, there is a slight variation) can be treated as an optimum exposure when reproduced, considering the film latitude and other factors. In the EM-2, the range has been fixed to this range for practical use.
- o Red lamps (A, A'):
The lamps light up for changes in the quantity of light of 1/3EV or more and 1EV or less to the overexposure or underexposure side.
- o Red lamps (B, B'):
The lamps light up for changes in the quantity of light in excess of another 1EV to either over- or underexposure side from the range where the A or A' lamp lights up.
- o When a right or left lamp lights up, jumping over the green lamp:
With the dial in that position, make slight adjustment of the aperture diaphragm or the illuminating light intensity, and the green lamp will light up.

(2) Reciprocity law failure lamp

This lamp lights up when the quantity of light that reaches the film surface (brightness of image) has become so small that it is not fit for photography. In other words, it lights up when the exposure time has become longer than 1/8 sec; and flashes more brightly as the exposure time becomes longer.

When the lamp lights up, the reciprocity law failure tends to occur. So if it is necessary to correct the exposure time, extend the exposure time, considering the characteristics of the film to be used. Refer to the reciprocity law failure and its correction in Section 9.

F. Large size film photography (4" x 5", 3-1/4" x 4-1/4" sheet film and Polaroid film)

- (1) Pull the optical path selection lever to change the path to photography.
- (2) Set the camera selection lever (17) to 4 x 5.
- (3) Select the lens magnification on the photographic eye-piece turret.
- (4) Set the shutter open/close button (2) of the controller to OPEN.
- (5) Determine the picture frame on the screen and focus the specimen image.
- (6) Operate the exposure time setting dial (4) and obtain the exposure time at which the green lamp lights up.
- (7) Set the shutter open/close switch (2) to CLOSE. (The image of the screen will disappear.)
- (8) Insert the sheet film holder and pull out the sliding cover.
- (9) Press the exposure button (3). The lamp of the shutter open/close switch will be on during exposure.
- (10) With the shutter open/close switch lamp going off, insert the sliding cover of the film holder to take it out.

G. 35 mm photography

- (1) Press the optical path selection lever to change over the optical path to observation.
- (2) Set the camera selection lever to 35.
- (3) Select the 3.3x lens (photo-eyepiece for exclusive use for 35 mm) on the photographic eyepiece turret and set it.
- (4) Make visual observation through the eyepiece and focus the specimen image accurately. (For the diopter adjustment of the eyepiece, follow the instructions of the microscope.)
- (5) Operate the exposure time setting dial (4) and obtain the exposure time at which the green lamp lights up.
- (6) Pull out the douser of the camera body.
- (7) Press the exposure button (3). During exposure, the lamp of the shutter open/close switch is on.
- (8) When the lamp of the shutter open/close switch goes off, take up the film by one frame and insert the douser of the camera body if necessary.

Note:

- o In 35 mm photography, make sure before operation that the shutter open/close switch of the controller is not in OPEN position. If it is in OPEN position, note that the film will be fogged, with the douser of the camera body being pulled out.
- o When operating the exposure button repetitively, do so at intervals of about 5 secs. If it is pressed successively, the shutter may not operate correctly.

H. Use of film sensitivity fine adjustment dial

- (1) In photography using a film whose sensitivity is other than that indicated on the sensitivity indicator (8) (for example, ASA-80), the desired sensitivity can be selected by means of the dial.
- (2) This dial is used in correcting the reciprocity law failure.

- (3) The dial is used when change in the over- or under-exposure conditions is desired by controlling the film sensitivity.

For the functions and use of this dial, refer to Section F on the AE-1 automatic exposure control on the preceding page.

I. Reciprocity law failure and its correction

Refer to Section H on the AE-1 automatic exposure control on the preceding page.

J. Density level fine adjustment screw

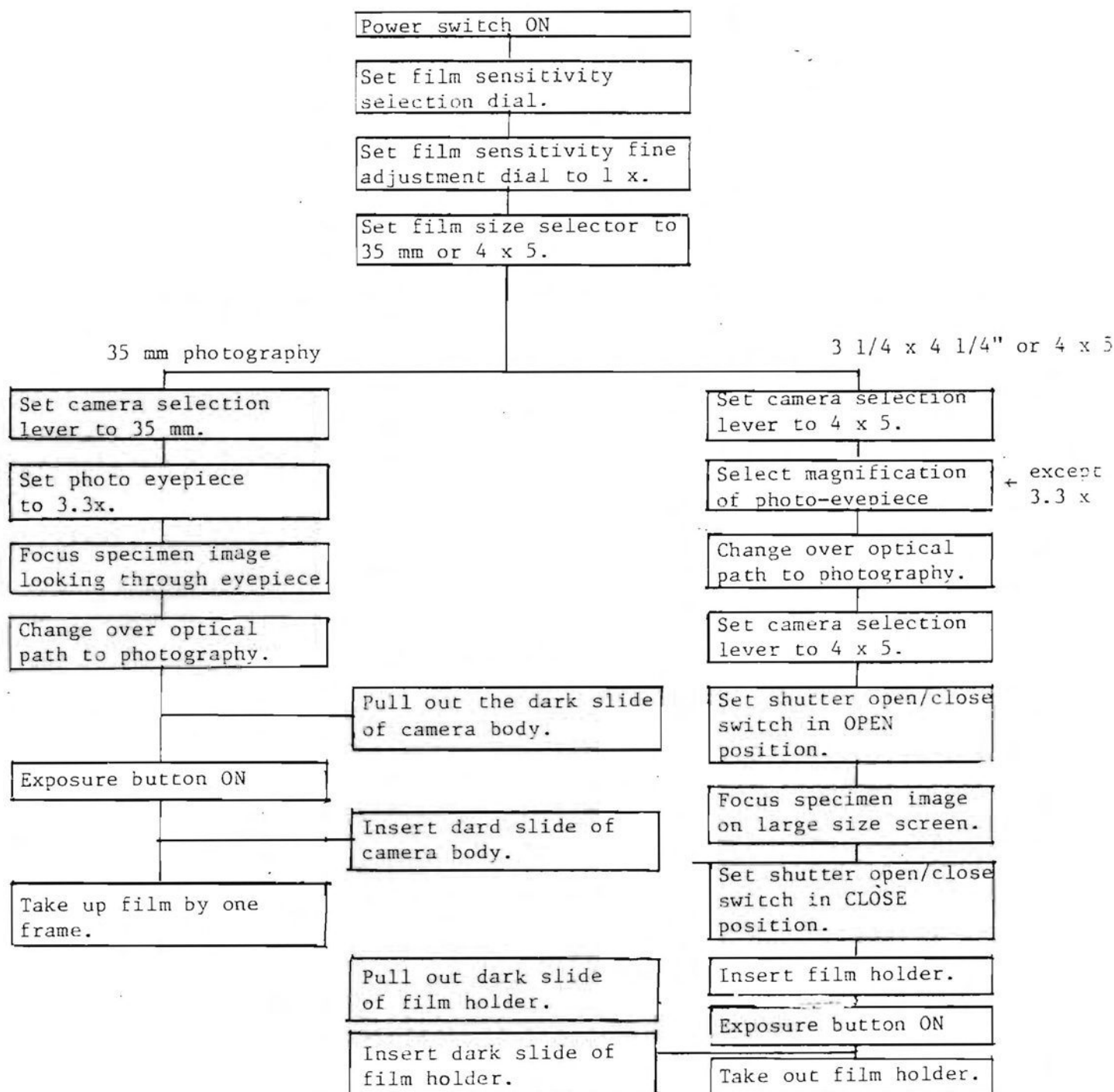
The density level fine adjustment screw located on the upper right of the controller rear panel is for changing the exposure level of the controller (density level of the negative film). Since the controller has been so set that the standard exposure level can be obtained, this screw will not be used. When it is necessary to change the conditions slightly, however, turn this screw slightly for fine adjustment.

Turning it clockwise increases the film sensitivity (consequently, causes underexposure) and turning it counterclockwise decreases the sensitivity (consequently, slight on the overexposure side). The adjustment range is 2 EV in the amount of exposure.

Note:

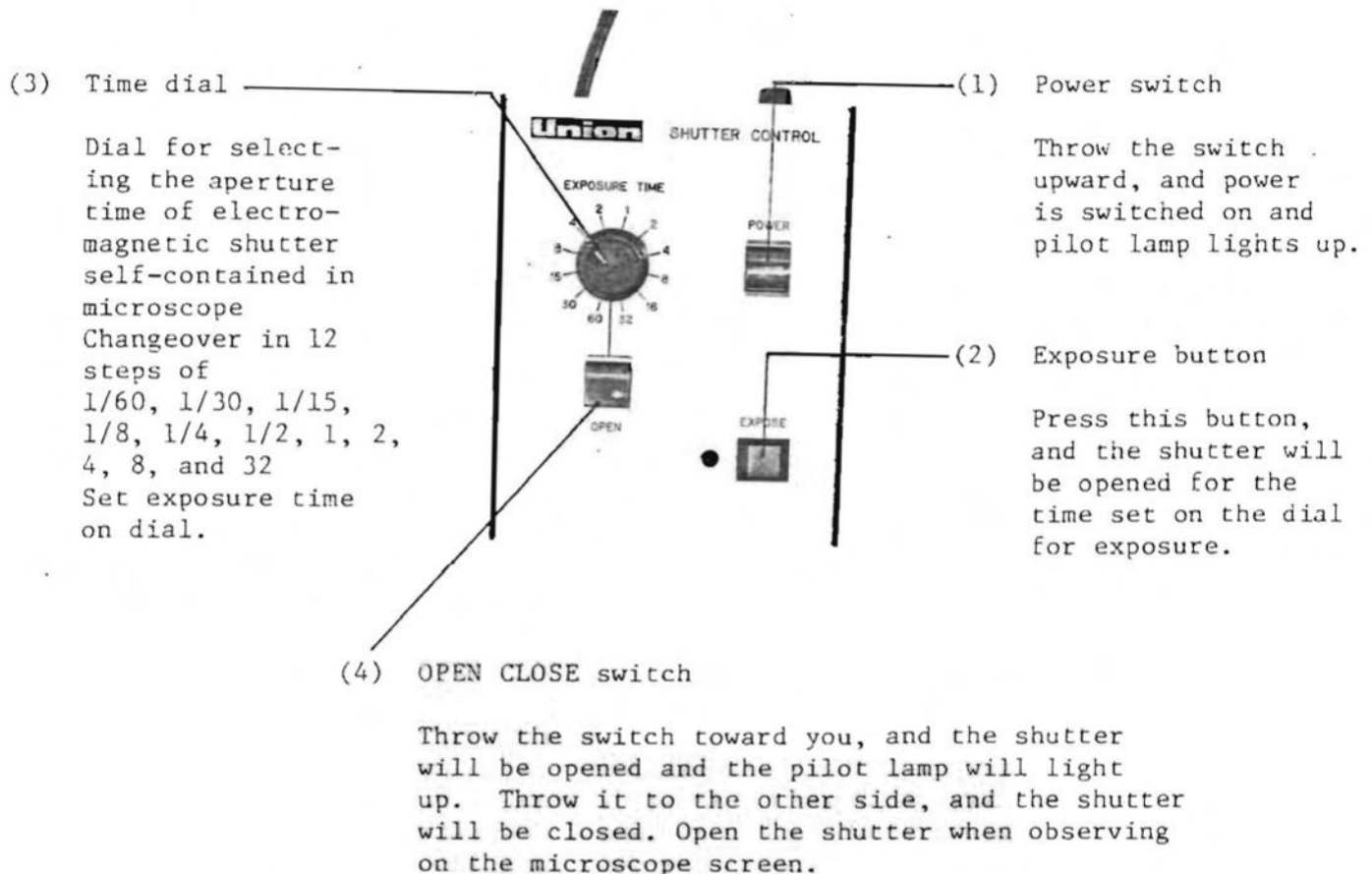
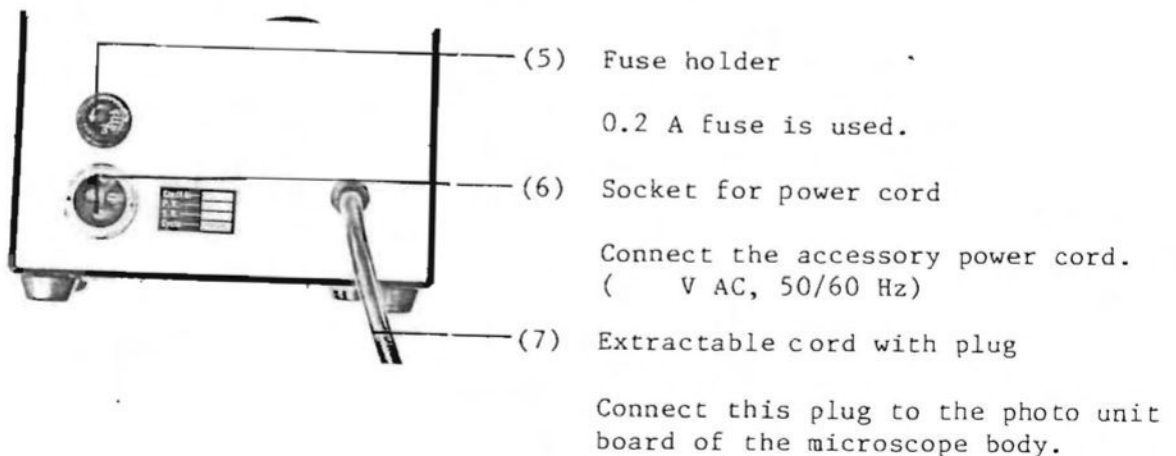
Except for the above purpose, never manipulate this screw, which is for changing the exposure level of the entire controller.

K. Flowchart of photomicrography by EM-2



XI. SC-1 SHUTTER CONTROL

1. Normenclature and functions



2. The UNIMET microscope supplied on your order incorporates an electromagnetic shutter in the body. This shutter must be externally and electrically controlled for open and close operation.
The SC-2 is a controller provided with shutter open/close control button, exposure time setting dial and exposure switching button.

3. Operation.

- (1) Connect the power cord and extractable cord to relative sockets.
- (2) Select an exposure time and set it on exposure time setting dial (3). The exposure time can be set to the following.
1/60, 1/30, 1/15, 1/8, 1/4, 1/2, 1, 2, 4, 8, 16, 32 in secs.
- (3) Upon completion of the preparation for photography, press the exposure switching button for photography. Upon completion of photography, the lamp of preview switch (4) goes off.

- o Do not press the exposure button successively but with intervals of about 5 secs.

- o For the photography procedure, refer to the Page .

(4) OPEN/CLOSE switch

This switch is operated in observation on the screen of the photographic contrivance or in focussing image large size film on the screen when making photographic work.

- i) Throwing this switch downward causes its lamp to light up and the shutter to be opened. Upon completion of fine focus on the screen, throw the switch upward to close the shutter.
- ii) In photography be sure to check that the switch is in OFF position (shutter closed) before pressing the exposure button.

(When the shutter is opened after it was closed by means of the OPEN/CLOSE switch, wait about 5 secs at least before pressing button.

(5) Long exposure

The maximum length of exposure time that can be controlled by the SC-1 controller is 32 sec. If longer exposure time is necessary, use the OPEN/CLOSE switch (4). Measure the necessary exposure time and, upon completion, turn off the OPEN/CLOSE switch.

XII. MR1 AND MR2 5X/10X MACRO PHOTO-ATTACHMENT
(EXTRA ACCESSORY)

1. The macro photo-mechanism includes the following components.
 - 1) 5x lens
 - 2) 10x lens
 - 3) Shutter (with shutter release)
 - 4) Reflection box
 - 5) Photo box cover

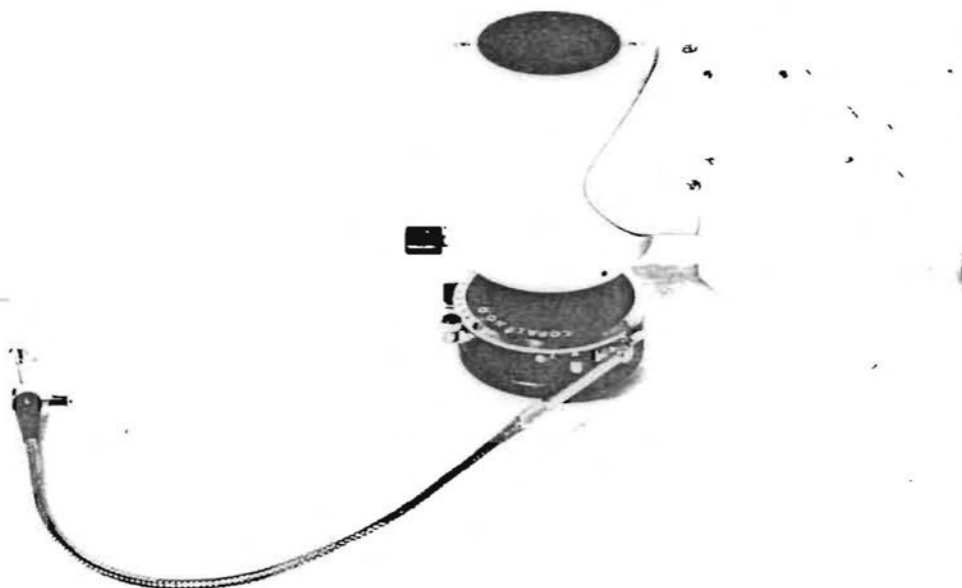
Note:

- o The shutter, reflection box and photo box cover can be used for both 5x and 10x lenses interchangeably and are necessary when either of the lenses is used.

2. Assembly

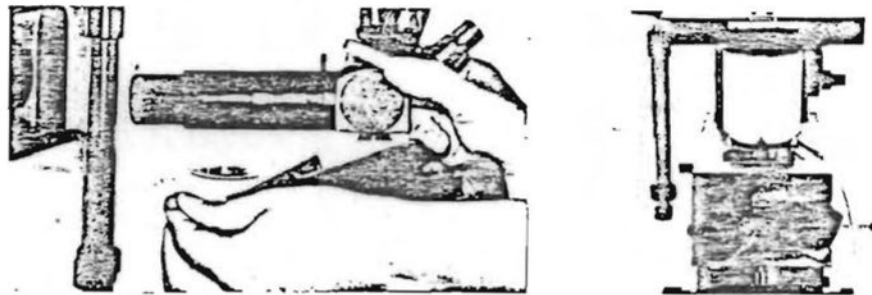
- (1) Assembly of macro lenses

Select either of the 5x or 10x lens and attach it on the shutter by screwing itself. Then insert the lens into the reflection box and fix it with a clamp screw.



(2) Mounting on the body

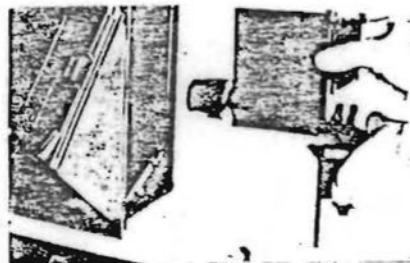
Remove the illumination transmission carrier of the body. Here, raise the stage up to the uppermost position. Loosen the clamp screw fastening the illuminator to remove it. Insert the round dovetail of the bottom of the shutter with the macro lens and clamp it with a clamp screw to fix it.



Then remove the "photo unit board" from the right of the microscope body. As shown in the figure, this board is fixed with two clamp screws. Loosen the clamp screw with a coin.



Remove the cord led from the exposure control. Pull the photo unit board holding it in a horizontal position. Here, loosen the clamp screw, push it upward slightly and pull it out horizontally. With the board removed, fit the photo box cover which is an accessory of the Macro Photo Attachment and lightly fasten it with a clamp screw.



3. Adjustment and observation

- (1) Thus preparation has been made. In observation by the macro photo-attachment, the focussing screen for large size film photography is used. Open the diaphragm of shutter which is attached to the lens by means of a shutter release and project the image onto the screen. The black knob outside the shutter is for arbitrary opening and closing of the shutter. When projecting an image onto the focussing screen, adjust this knob to the red mark "S" and then the shutter will be opened.
- (2) Then focus the specimen image on the screen by controlling the coarse and fine focusing knobs and make sure there is no unevenness of brightness (of illumination) on the screen. If there is any unevenness, slightly loosen the clamp screw of the refelection box and slightly swing it in the circumferential direction so that the center of the illuminating light beam is positioned correctly in the reflection box.
- (3) The shutter for the macro lens can be opened with the desired aperture appropriately controlled. For greater focal depth or higher contrast, try to control the aperture properly.

4. Photography

- (1) With the macro lens, photography of large size film or by the Polaroid film can be made. For operation of these holders, follow the instructions on large size film photography, in general.
- (2) Determine the picture frame on the focussing screen and focus the specimen image by controlling the coarse and fine focusing knobs.

- (3) Then set the exposure time. Here, adjust the black knob on the periphery of the shutter to red mark 0 and close the shutter. With the exposure time set, set the shutter change lever and press the cable release for exposure.

XIII. USE OF MR-4 PHOTO-MECHANISM

A. 35 MM Camera attachment

- (1) The 35 mm camera attachment consists of the following components.

- 1) 35 mm camera coupling tube,
With built-in lens for
photography
- 2) 35 mm camera FUJIKA
ST605MK II
- 3) Finder reticle (FS-7)



(2) Installation and photography

- 1) Remove the mount cap from the lower part of the rectangle arm of the body frame of the microscope
- 2) Mount the camera body on the 35 mm coupling tube (with a film loaded in the camera body). Install this camera assembly on the mount in the lower part of the rectangular arm of the body frame, on which a red dot is marked. Hold the camera mounted on the 35 mm coupling tube, with the upper surface of the camera body positioned on the front of the microscope and match the red dot of the mount of the coupling tube with that of the mount of the tube. Then, turn the bayonet ring clockwise, and the camera body will be fixed.
- 3) When the manual exposure is used in conjunction, install the light receptor element on the coupling tube and connect it to the exposuremeter by means of a cord.

In installing the light receptor element, remove the blind cover of the receptor mounting port of the 35 mm coupling tube and insert the receptor mount into it gently along the pin guide and fix it by tightening the coupling.

o Thus the preparation for photography is completed.

Replace the finder reticle (mounted on frame) with the scale reticle mounted to the bottom of the eyepiece.

Adjust the eyepiece diopter in accordance with the finder reticle.

- 4) Focus the specimen image looking through the eyepiece.
- 5) Measure the exposure
Pull out the optical path selection lever to change it over to the photography side. Then push in the light receptor of the 35 mm coupling tube. The light receptor goes into the optical path on the photography side and starts photometry, and the exposuremeter is actuated. With the hand off the receptor, it moves out of the optical path. For operation of the exposuremeter, refer to the relative sentences in the preceding page.
- 6) Set the shutter speed
Set the shutter speed dial of the 35 mm camera body to the exposure time determined.
- 7) Release the shutter
Release the shutter gently with the cable release.
- 8) Prepare for the next photography
Wind up the film with the film winding lever of the camera body. Then change over the light path to the observation side again and repeat the operation in par, (4) and succeeding paragraphs.

B. POLAROID land (3"x 4") camera attachment

(1) The Polaroid Land (3" x 4") camera attachment consists of the following components.

- 1) Polaroid attachment
Polaroid Back model
101
With built-in photographic lens 10x and shutter.
- 2) Shutter release
- 3) Finder reticle



(2) Installation and photography

- 1) All the installation procedures of this mechanism and connection of the light receptor when the manual exposure meter is used in conjunction are the same as in the case of 35 mm photo-mechanism. So follow the procedures for the 35 mm photo-mechanism.
- 2) Loading of film
 - a. Release the metal film clip on the side of the camera, and the back lid can be opened.
 - b. Open the back lid to the left side.
 - c. Take out the film from the bag. The film is in a film pack. Take care not to hold the pack strongly in the vertical direction.
 - d. Load the film pack into the camera.

- e. Close the back lid of the camera and fix it with the metal film clip.
- f. Check that the sliding plate of the camera is pushed in firmly, draw out the white paper from the lower part of the right side of the camera, and the tip of black paper will come out from the upper part. Draw out the paper straight, holding the tip firmly.

Thus, the preparation for photography of the first picture is completed.

3) Focussing the camera

Replace the finder reticle (mounted on frame) with the scale reticle mounted to the bottom of the eyepiece (same as for the 35 mm photo-mechanism). Adjust the eyepiece diopter accurately in accordance with the finder reticle. Set the optical path selection lever to the observation side by pushing it in. Focus the specimen image looking through the eyepiece.

4) Measure the exposure

Change over the optical path selection lever to the photography side by pulling it out. Then activate the exposuremeter by pushing in the receptor to receive light and read the exposure time.

5) Set the shutter speed

Set the shutter speed dial built-in in the poraloid attachment to the exposure time obtained.

6) Release the shutter

Release the shutter gently with the cable release.

7) Unload the film

The film is to be unloaded according to the instructions which accompany the Poraloid film, as described below.

- a. Hold the camera and pull the white paper in the lower part of the side of the camera until it is completely drawn out.

The tip of black paper is seen in the upper part on the side. Draw out the black paper slowly with uniform force. Otherwise, development does not start. In drawing the paper, take care not to hesitate or draw too slowly.

- b. When the paper is drawn out completely, separate it into two sheets after about 10 seconds.
- c. Development begins when the paper is drawn out. At the same time, the camera is ready for the next photography. Although the development time differs depending on the conditions, it is about 10 seconds in most cases. However, it is necessary to examine the conditions carefully. The time varies widely according to the type of film and photographing conditions.

Note:

The development time of 10 seconds is the time under normal temperature (15 to 32°C). If the development time is less than 6 to 7 seconds, the photograph will not be suitable for practical use as the picture image is too dark. On the contrary, if the development time exceeds 10 seconds, there is no adverse effect on the picture image with the contrast becoming slightly sharper. However, when the ambient temperature is low (below 4°C), it is necessary to develop the film for more than 30 seconds.

- d. Apply the coating agent supplied with the film to the printing paper as quickly as possible. Application of this agent does not discolor the photograph. Place the photograph on a flat place or on the film box and apply the coating agent to every nook and corner 7 to 8 times carefully and rather strongly.

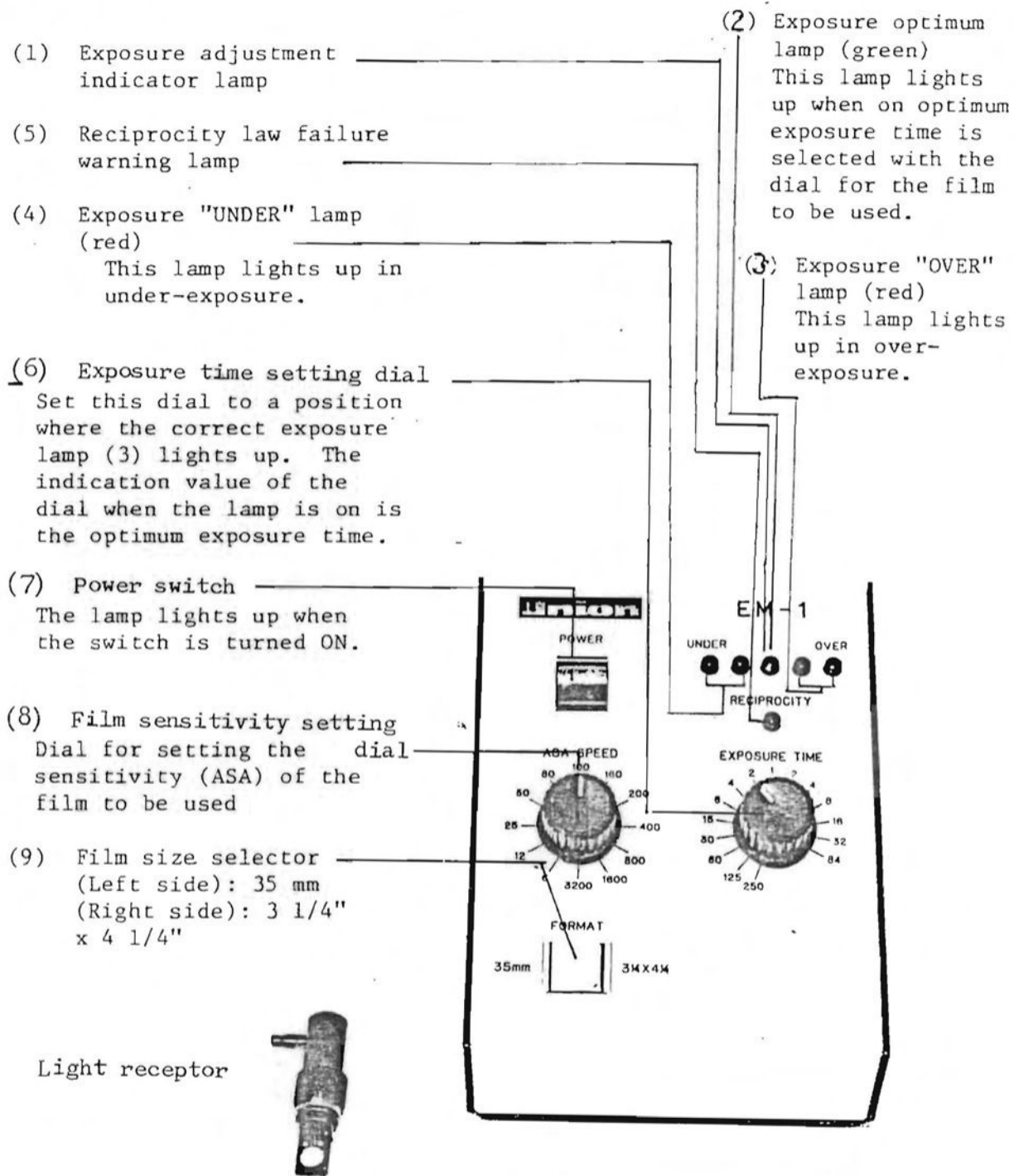
XIV. USE OF EM-1 MANUAL EXPOSUREMETER

The model EM-1 exposuremeter is a manual exposuremeter which has been specially developed for the UNIMET MR-4. It employs a high sensitivity photodiode for the receptor and permits easy operation and highly reliable measurement.

A. Specifications of EM-1 manual exposuremeter for unimet MR-4

Exposure time setting range	15 steps from 1/250 to 64 sec. 1/250, 1/125, 1/60, 1/30, 1/15, 1/8, 1/4, 1/2, 1, 2, 4, 8, 16, 32, 64 By reading dial
Film speed range of film used	12 steps from ASA6 to 3200 6, 12, 25, 50, 80, 100, 160, 200, 400, 800, 1600, 3200
Format of film	35 mm and 3 1/4 x 4 1/4 by switch changeover
Exposure adjustment indication	The LED lamp display shows optimum, overexposure and underexposure. With the "EXPOSURE TIME" dial changed over, when the green lamp in the center light up, the exposure time is correct. If the "UNDER" or "OVER" lamp lights, the exposure time selected on the dial is under or over the optimum exposure by 1EV respectively.
Reciprocity law failure alarm	When the exposure time is longer than 1/8 second, the lamp becomes on with gradually increasing brightness. This warns that in this range, the exposure correction must be made depending on the type of the film used. Note that the automatic correction is not made in the meter.

B. Nomenclature and functions



C. Features of EM-1 exposuremeter

(1) Exposuremeter with no meter

The optimum exposure condition can be known instantly by dial operation alone. When the light receptor is activated, the LED lamp gives the operator the information on the optimum, under- and overexposure.

(2) Reciprocity law failure warning lamp is provided.

It is provided with a lamp which warns the operator of the reciprocity law failure before it occurs when a longer exposure time is required. By correcting the exposure time by this warning, photography can be carried out with no reciprocity law failure.

D. Preparations

(1) Installation of light receptor

Install the light receptor on the main body of the 35 mm camera attachment or Polaroid Land Camera attachment. Insert the light receptor gently into the main body by matching its guide groove with the guide pin at the receptor inserting port of the main body and fix it securely by tightening the nut.

(2) Cable connection

Connect the cable for light receptor to the socket on the rear of exposure controller.
Connect the power cord to the controller and connect other end of the cord to an AC electric power source.

E. Operation

(1) Throw the power switch (7) on the control panel forward, and the power is switched on and the pilot lamp lights up.

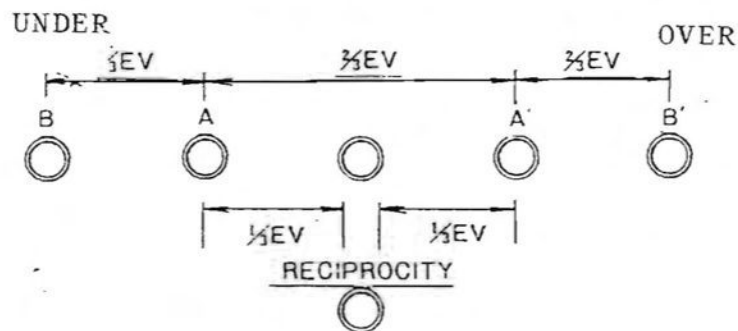
(2) Set the sensitivity (ASA) of the film to be used by means of the film sensitivity setting dial (8) (ASA SPEED). If the sensitivity value of the film to be used is not on the setting dial, refer to page .

The selectable ASA sensitivities are shown below.
6, 12, 25, 50, 80, 100, 160, 200, 400, 800, 1600, 3200 (changed over in 12 steps)

- (3) Set the film size selector knob (9) according to the film to be used. By turning it to left, <35 mm> is selected and by turning it to right, <3 1/4" x 4 1/4"> is selected.
- (4) Determine the exposure time and set it on the exposure time setting dial (6) (EXPOSURE TIME). One of the following exposure times can be selected. 1/250, 1/125, 1/60, 1/30, 1/15, 1/8, 1/4, 1/2, 1, 2, 4, 8, 16, 32, 64 (in sec.)
- (5) The Poraloid attachment for MR-4 has been parfocally adjusted to the focus of the eyepiece. Make diopter adjustment by replacing the finder scale for photography with the micro scale reticle of the eyepiece for observation. Focus an image of the specimen with the fine focus control knob and determine the frame of finder scale in connection with the film size.
- (6) Pull out the optical path selection knob and change over optical path to the photo side.
- (7) Push in the light receptor portion attached to the 35 mm camera attachment or Poraloid camera attachment with a finger. Under this condition, the light receptor intercepts the optical path on the photo side, thereby photometry being made. With the finger released the receptor is returned and light is not measured.
- (8) Check that the green lamp in the center of the exposure determination lamps (optimum exposure indication lamp) is on in the photometric condition. If the green lamp is on, the exposure time set is correct. If a lamp to the left of the green lamp is on, slowly turn the exposure time setting dial clockwise and if the lamp to the right is on, slowly turn the dial counterclockwise. When the green lamp in the center is on, the exposure time set at that time is appropriate.
- (9) When an optimum exposure time is determined, set it to the shutter time for the 35 mm camera attachment or the Poraloid camera attachment and make exposure by pushing the cable release gently.

F. Exposure determination lamp

The five LED lamps to determine the optimum exposure have been adjusted so as to light up according to the change in level of the quantity of light (indicated in EV value).



(1) Green lamp (optimum exposure indication lamp)

This lamp lights when the quantity of light changes within the range of $\frac{1}{3}$ EV to the over- or underexposure side from the optimum exposure value. For changes within this range, the correctly exposed picture can be obtained because of the latitude of the film.

(2) Red lamps A,A' (Overexposure or underexposure)

This lamp lights when the quantity of light changes to the under- or overexposure side by $\frac{1}{3}$ EV to 1EV on each side.

(3) Red lamps B,B' (Overexposure or underexposure)

This lamp lights when the quantity of light changes from the value at which lamps A and A' light to the under- or overexposure side further by more than 1EV on each side.

Note:

If a lamp on the right or left lights up jumping over the green lamp, leave the dial as it is and slightly adjust the light or the light intensity of the illuminating lamp. And the green lamp will light up.

If the "UNDER" or "OVER" lamp lights, it indicates underexposure or overexposure by 1EV respectively on the selected exposure time dial.

(4) Reciprocity law failure warning lamp (RECIPROCITY)

The warning lamp for reciprocity law failure (RECIPROCITY) lights increasingly brightly as the exposure time becomes longer than 1/8 seconds. This warns the operator of the necessity of exposure correction in this range depending on the type of film to be used.

In short, it is so designed that the lamp lights up when the quantity of light received on the film is small and photographing conditions become critical for the film. Since the reciprocity law failure tends to occur when this lamp is on, correct the exposure beforehand in accordance with the curve of reciprocity law failure.

G. Use of exposure determination lamp

Since the exposure determination lamp can be adjusted in units of EV, the following adjustments can be made.

- o Conditions of over- and underexposure can be changed optionally.
- o The film sensitivity (ASA) value which is not on the film sensitivity setting dial can be set.
- o Can be used for the correction of the reciprocity law failure.

The variable range of the exposure determination lamp (LED lamp) is plus or minus one step each (3/3EV) and film sensitivity and amount of exposure (exposure time) change as shown below.

Change in exposure amount	UNDER		0	OVER	
	-1EV	-1/3EV		1/3EV	1EV
Change in exposure time	5	8	10 times	13	20
Change in film sensitivity	200	130	100	80	50
Correction value	0.5	0.8	1.0 times	1.3	2.0

Note:

In the above table, changes in the film sensitivity are based on ASA 100 as standard and the changes in the exposure time are based on the exposure time of 10 seconds at ASA 100 and 0 EV.

- (1) The overexposure and underexposure can be adjusted optionally.

For example, if the green lamp (optimum exposure indication lamp) lights at the exposure time of 10 seconds with (ASA-100) and if overexposure or underexposure is intended, photography can be done with the desired exposure time by setting the exposure time setting dial in such a way that the $\pm 1/3EV$ lamp or $\pm 1EV$ lamp lights up.

- (2) The film sensitivity which is not set on the film sensitivity setting dial can be set

The sensitivity (ASA) of most commercially available films can be set by means of the film sensitivity setting dial (8). If you want to set ASA-64, for instance, set the sensitivity to 80 by means of the film sensitivity setting dial and set the exposure time setting dial to a value at which the $1/3EV$ lamp (B' lamp) of the underexposure side lights up ($80 \times 0.8 = 64$). The selected exposure time at which this lamp (not the green lamp) lights up is the optimum exposure time for the ASA-64 film.

- (3) The reciprocity law failure can be corrected.

The warning of the reciprocity law failure by the "RECIPROCITY" lamp allows the failure to be corrected before it occurs.

The reciprocity law failure can be corrected by two ways; (1) correction of the film sensitivity and (2) correction in the development process. Here, the correction of film sensitivity is practicable. For the reciprocity law failure and its correction, refer to Section H, instructions on the AE-1 Automatic Exposure Control. The correction is to be made by means of the sensitivity fine adjustment dial in the model AE-1, but in this unit, the correction can be made by obtaining a correction EV value in the same manner as in Par. (1) and by setting the exposure time dial to a value at which the corresponding lamp lights up.

XV. TRANSMITTED LIGHT ATTACHMENT (EXTRA ACCESSORY)

The transmitted light attachment for model MR1, MR2 and MR-4 are all the same, except for the lamp and socket. That for the models MR1 and MR2 employ 12 V, 50 W halogen lamps and that for MR4 employs a 6 V, 200 W halogen lamp.

A. Transmitted light attachment

- (1) The attachment includes following components:

- | | | |
|-----|--------------------------------------|------------|
| (1) | Rod | |
| (2) | Support bracket | |
| (3) | Lamphouse | |
| (4) | Condenser | |
| (5) | Filter | |
| | (Green and blue (frosted)) | 1 pc. each |
| (6) | Stage clip (for biological specimen) | 2 pcs. |
| (7) | Slide glass | 5 pcs. |
| (8) | Bulb cord | 1 pc. |

- (2) Installation and adjustment

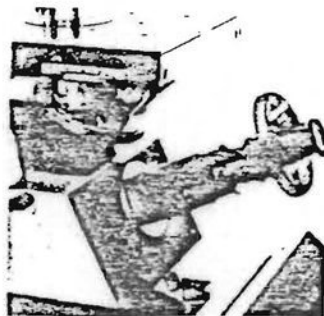
- (1) Remove the blind cover on the upper face of the stage bracket of the UNIMET mainbody and thrust the rod into the stage bracket and fix it.
- (2) Mount the support bracket through the rod and fix it. Then install the lamphouse (with a condenser) on the bracket and fix it with a clamp screw.
- (3) Connect the plug of the bulb cord to the socket for transmitted light on the rear of the microscope base.
- (4) Change over the rear switch of the microscope base for transmitted light illumination, turn on the main switch on the front panel of the base and adjust the light intensity.
- (5) Bring the end of the condenser close (Approximately 4 mm) to the specimen and focus the image of the specimen viewing through the eyepiece.

- (6) If the brilliance is not uniform or uneven in the field of view, adjust the core of the condenser with respect to the filament by means of the two clamp screws on the condenser frame so that the brilliance becomes uniform.

XVI. AUSTENITE GRAIN SIZE MEASURING TURRET EYEPiece

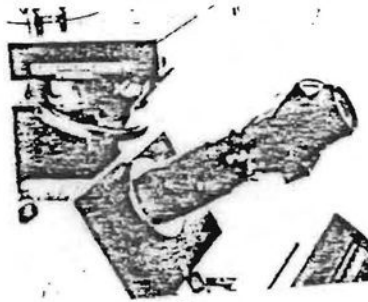
This eyepiece is used for measuring the austenite grain size of steel stipulated by the JIS standard. The standard chart is provided on a turret. It is used in conjunction with a single tube specially designed for it.

In installing the eyepiece on the main body, replace the binocular body with the single tube for exclusive use and mount the eyepiece on it as shown in the photo below. As the single tube is adjustable, set the eyepiece so as to match the line just below the knurled collar of the single tube sleeve. (Another line is marked with 170TL. The ordinary eyepiece can be used at this position as a monocular tube.



XVII. FILAR MICROMETER EYEPIECE

This eyepiece is used for most critical linear measurements of cell size and plating thickness. It is used in conjunction with the single tube for exclusive use as in the case of the grain size measuring eyepiece. The adapting method is also same.



XVIII. SENSITIVE TINT PLATE

- (1) This is used to detect and observe double refraction materials with enhanced contrast in observation with polarized light. For use, it is inserted into the optical path with the lever as shown in the figure. When the plate is moved out of the optical path by pulling out the lever, the instrument can be used as an analyzer.
- (2) To install this plate, remove the optical transmission carrier from the main body and take out the analyzer by unscrewing the clamp screw located in the front of the transmission carrier. Insert the sensitive tint plate into the analyser slide plate and fix it to the main body by tightening the clamp screw and mount the illuminator on the main body.

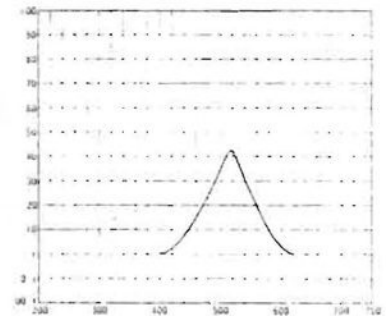


XIX. FILTER

On the illuminator of the UNIMET, two filters are mounted, green (G) filter and blue (B) filter.

A. Green filter

The green filter has the characteristics as shown in the characteristic chart below. This filter serves to improve contrast in visual observation and photography and to reduce strains on operator's eyes. Always use it in the optical path in brightfield observation. It can also be used in photography using a monochrome film.



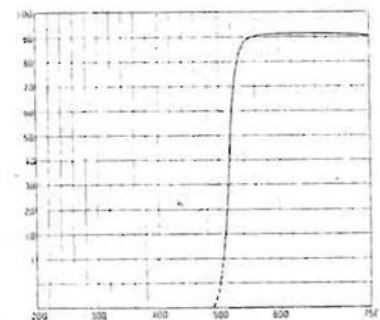
Characteristic curve of green filter

B. Blue filter

This filter is used only in color photography using a daylight type color film. It is not necessary to use it in normal observation. Refer to the paragraph "Use of color film".

C. Auxiliary filter

For the UNIMET, a yellow (Y) filter is provided as an auxiliary filter (available at extra cost). This filter is the so-called sharp-cut filter and has the characteristics shown by the following curve. This filter can be used effectively when the exposure time becomes longer because of the use of the green filter. It can also be used effectively as a contrast filter like the green filter, as well as in conjunction with a green filter.



Characteristic curve of yellow filter

XX. OPTICAL PERFORMANCE

A. Optical performance of objective lens

Item Objective	Magnification	Numerical aperture (NA)	Working distance ED(mm)	Focal distance f(mm)	Resolving power (μ)	Focal Observation	depth Photography	Real field of view (mm ϕ)	Remarks
MF Objective lens	5x	0.12	7.50	33.41	2.80	42.9	19.1	3.6	Brightfield
	10x	0.25	6.18	15.74	1.34	10.11	4.40	1.8	
	20x	0.40	2.10	8.60	0.84	3.51	1.72	0.9	
	40x	0.65	0.34	4.23	0.52	1.20	0.65	0.45	
	80x	0.90	0.26	2.02	0.37	0.54	0.34	0.23	
Plan M objective lens	10x	0.20	5.75	16.44	1.68	14.02	6.88	1.8	Brightfield
	20x	0.40	1.10	7.63	0.84	3.51	1.72	0.9	
	40x	0.65	0.71	4.06	0.52	1.20	0.65	0.45	
	100x	0.90	0.25	1.67	0.37	0.5	0.34	0.18	
Epi MF Objective lens	5x	0.12	7.50	33.41	2.80	42.9	19.1	3.6	Brightfield Darkfield
	10x	0.25	6.18	15.74	1.34	10.11	4.40	1.8	
	20x	0.40	2.10	8.60	0.84	3.51	1.72	0.9	
	40	0.65	0.34	4.23	0.52	1.20	0.65	0.45	

B. Optical performance of macro lens

Item Lens	Numerical aperture (NA)	Working distance WD(mm)	Focal distance f(mm)	Real field of view (mm ϕ)
MACRO x5	0.05	73.5	87.77	19 x 24
MACRO x10	0.07	73.5	49.52	9.5 x 12

C. Optical performance of eyepiece

Item Eyepiece	Magnification	Eye point (mm)	Field number	Sleeve diameter (mm)
NWF eyepiece	10x	17	18	23.2

D. Observation, magnification and photographic magnification

	Eyepiece photographic lens	Objec- tive lens 5x	Objec- tive lens 10x	Objec- tive lens 20x	Objec- tive lens 40x	Objec- tive lens 80x	Objec- tive lens 100x
Ocular observation	NWF10x	50x	100x	200x	400x	800x	1000x
Large size film photo- graphy screen observation 35 mm photography	Photo 10x	50x	100x	200x	400x	800x	1000x
	Photo 12.5x	62.5x	125x	250x	500x	1000x	1250x
	Photo 15x	75x	150x	300x	600x	1200x	1500x
	Photo 20x	100x	200x	400x	800x	1600x	2000x
	Photo 3.3x	16.5x	33x	66x	132x	264x	330x