

Nikon

MEASURING MICROSCOPE
MM-40/60 Series

< with trinocular optical head >

< with focus aid optical head >

Instructions

Thank you for purchasing the Nikon product.

This instruction manual is written for the users of Nikon's measuring microscope MM-40/60 series with trinocular or focus aid optical head.



To ensure correct usage, read this instruction manual carefully before operating the instrument.

- It is prohibited to alter this manual in part or whole without expressed permission.
- The contents of this manual are subject to change without notice.
- Some products introduced in this manual may not be included in the set you've purchased.
- Although every effort has been made to ensure the accuracy of this manual, if you note any points that are unclear or incorrect, contact your nearest Nikon representative.
- Also be sure to read the instruction manual for any instrument that you use with this measuring microscope.



WARNING / CAUTION SYMBOLS USED IN THIS MANUAL

Though Nikon products are designed to provide you with the utmost safety during use, incorrect usage or disregard of the instructions may cause personal injury or property damage. For your own safety, read the instruction manual carefully and thoroughly before using the product. Do not discard this manual. Always keep it near the product for easy reference.

Inside this instruction manual, safety instructions are indicated with the symbols shown below. Be sure to follow the instructions marked with these symbols for your safety.

Symbol	Meaning
 WARNING	Disregarding instructions marked with this symbol may lead to death or serious injury.
 CAUTION	Disregarding instructions marked with this symbol may lead to injury or property damage.

SYMBOL LABELS ATTACHED TO THE PRODUCT

Symbol	Meaning
 	<p>This label near the lamphouse calls your attention on the following;</p> <p>Warning for heat.</p> <ul style="list-style-type: none">• Lamp and the lamphouse becomes very hot when the lamp is on and immediately after the lamp is turned off.• To prevent burns, do not touch the lamphouse and its surroundings when the lamp is on and for at least thirty minutes after you turn off the lamp.• To avoid the risk of fire, do not place any fabrics, paper, or highly flammable materials such as gasoline, benzene, paint thinner or alcohol near the lamphouse when the lamp is on and for at least thirty minutes after you turn off the lamp.• To prevent burns, make sure that the lamp and the lamphouse is sufficiently cool before the lamp replacement.• To prevent electrical shocks, turn off the power switch (flip it to the "○" side) and unplug the power cord before the lamp replacement.• Be sure to use the specified lamp. The use of other lamps may lead to fire or malfunction.



WARNING

1. Intended product use

This product is a precision measuring instrument. It should only be used for microscopic observation and measurement. Do not use it for any other purpose.

2. Do not disassemble

Attempting to disassemble this instrument could result in electrical shocks or damage. Never attempt to disassemble any portion of the instrument unless the procedure is described in this manual. If you have any problems with the instrument, contact your nearest Nikon representative.

3. Confirm the input voltage setting

Make sure that the input voltage selector at the rear panel is set to match your local supply voltage. If not, reset the selector according to the instructions on page 9. The use of the instrument with the incorrect input voltage setting will cause shortage that leads to fire, electrical shocks and malfunction.

Before changing the input voltage selector, turn off the power switch (flip it to the "○" side) and unplug the power cord to prevent electrical shocks.

Input voltages that can be set: AC 100V, AC 120V, AC 230V

4. Use the specified power cord

Be sure to use the power cord specified at the Electrical Specifications at the end of this manual. The use of other cord may lead to fire or malfunction.

Before connecting the power cord, turn off the power switch (flip it to the "○" side) to prevent electrical shocks.

5. Use the specified fuse

Be sure to use the fuse specified at the Electrical Specifications at the end of this manual. The use of other fuse may lead to fire or malfunction.

Before replacing the fuse, turn off the power switch (flip it to the "○" side) and unplug the power cord to prevent electrical shocks.

6. Heat from the light source

The lamp and the lamphouse become extremely hot when the lamp is on. Be careful not to get yourself burnt.

- Do not touch the lamp and the lamphouse when the lamp is on and for at least thirty minutes after you turn off the lamp.
- Do not place any fabrics, paper, or highly flammable materials such as gasoline, benzene, paint thinner or alcohol near the lamphouse when the lamp is on and for at least thirty minutes after you turn off the lamp. There is a risk of fire.



CAUTION

1. Confirm the light source

The combination of the lamp and the lamphouse is specified at the Electrical Specifications at the end of this manual. If the other combination is used to light the lamp, fire or malfunction may occur.

2. Turn off the power during lamp exchange and cable connection / disconnection

To avoid electrical shocks, malfunction, or damage to the instrument, turn off the power switch (flip it to the "○" side) and unplug the power cord before lamp exchange and cable connection/disconnection.

3. When exchanging the lamp

- To prevent burns, allow the lamp to cool (for at least thirty minutes after the lamp has been turned off) before exchanging the lamp.
- Before exchanging the lamp, turn off the power switch (flip it to the "○" side) and unplug the power cord to avoid electrical shocks and malfunction.
- After exchanging the lamp, make sure that the lamphouse cover is securely closed. Never light the lamp when its cover is open.
- A lamp could break by dropping it, striking it, applying excessive force to it, scratching it, or other such actions. Be very careful to avoid injuries from the broken glass.
- Keep burned out lamps intact when disposing of them. Breaking a lamp could result in injuries due to broken glass.

4. The weight of the instrument

The instrument weighs approximately 100 kg in its standard operational form. Be very careful on the following to avoid the accidents and malfunction caused by dropping the instrument.

- Remove the stage before moving the instrument.
- The center of gravity is at the supporting pillar in the rear. Be careful not to tip over the instrument when lifting it up.
- Do not hold the focusing mount, the optical head or the sheet metal cover at the rear of the base. They may come off.
- Set the instrument on a solid work table.
- Avoid using the instrument on an unsteady or bent table.
- Be careful not to get your hands or fingers caught under the instrument. unplug the power cord to prevent electrical shocks.



CAUTION

5. Do not wet the instrument

If the instrument gets wet, a short circuit may result that could damage the instrument or make it extremely hot. If you accidentally spill a liquid on the instrument, immediately turn off the power switch (flip it to the "O" side) and unplug the power cord. Then dry the instrument with a piece of cloth or the like. If the liquid gets inside the instrument, contact your nearest Nikon representative. Do not use the instrument.

Notes on Handling the Instrument

1. Location for installation

Note on the following when installing the instrument

- Install the instrument in a location with constant temperature and humidity, or in a dry location. If the instrument is installed in a warm, humid location, condensation or mold may form on the lenses, degrading performance or damaging the equipment.
- Install the instrument on a flat surface with little vibration.
- Install the instrument in a location that is free of dust or dirt. When not in use, put a vinyl cover on the instrument so that it will not be covered by dust.
- Install the instrument on a solid work table. Avoid using the instrument on an unsteady or bent table.
- Maintain the top surface of the table level. Remove dust from the table before installing the instrument.

2. Keep the lenses clean

To get the bright and sharp image, keep all the lenses (such as eyepieces and objectives) clean.

Notes on Handling the Instrument

3. Handling the lamps

- Do not touch the glass bulbs with your bare hands. Doing so will dirty the lamp surface, resulting in degraded performance, damage to the lamp, and/or a shortened operational life. When handling lamps, either wear gloves or else use a cloth. If a lamp does get dirty, wipe it clean with a cloth moistened with alcohol.
- Do not apply paint or other substances on a lamp bulb. Doing so will cause a lamp to overheat, resulting in damage to the lamp.
- Do not vibrate or strike a lamp. Doing so may shorten the operational life of the lamp or damage the lamp.
- Install the lamp securely to their sockets. If not, they may fall out, or may overheat and smoke due to poor contact. Before installing a lamp, make sure that the socket contacts are in good condition. The lamps may not light or may overheat by damaged contacts.
- When installing or removing a lamp, check the type of base. (Some lamps are screw-in types, others are plug-in types.) Trying to install a lamp by the wrong method could damage the lamp.

4. Do not loosen the coarse torque adjustment ring too much

Do not make the coarse torque adjustment ring (on the coarse focus knob or handle) too loose. The focusing mount may fall down on its own weight and damage your sample or objective.

5. Do not rotate the coarse focus arm while it is fixed by the HOLD knob

(when using the 3-stage handle only)

Do not rotate the coarse focus arm while it is fixed by the HOLD knob (while the HOLD knob is turned all the way clockwise). When you need to rotate the arm, be sure to loosen the HOLD knob (turn it all the way counter-clockwise) so that the arm can be rotated freely.

6. Move up the optical head for focusing with higher magnification objectives

Higher magnification objectives have shorter working distances (W.D.). To prevent the objective tip from hitting the sample, first lower the optical head while observing the clearance between the objective and the sample, and then focus by raising the optical head from the point slightly lower than the W.D. of the objective.

MEASURING MICROSCOPE

MM-40/60 Series

< with trinocular optical head >

< with focus aid optical head >

CONTENTS

WARNING AND CAUTIONS

WARNING / CAUTION SYMBOLS USED IN THIS MANUAL.....	ii
SYMBOL LABELS ATTACHED TO THE PRODUCT	ii
⚠ WARNING	iii
⚠ CAUTION	iv
Notes on Handling the Instrument.....	v

I. NOMENCLATURE AND FUNCTIONS

1. Front view	2
2. Right-side view	3
3. Rear view	5

II. ASSEMBLY

1. Base	7
2. Stage (optional).....	7
3. Optical head	7
4. Binocular eyepiece tube	7
5. Eyepieces	7
6. Objective	7
7. Lamp and lamphouse	8
8. Input voltage selector and fuse	10
9. Power cord	11

III. MEASUREMENT

1. Illumination	12
2. Setting the sample	13
3. Focusing	14
4. Setting-out adjustment of the stage	14
5. Using the focus knob	16
6. Examples of measurement	18

IV. OPTIONAL ACCESSORIES

1. 10' reading protractor eyepiece.....	23
2. 1' reading protractor eyepiece.....	23
3. Concentric circles (reticle).....	23
4. Stages	24
5. Point sensor	24
6. TV camera adapter	24
7. Ring illumination.....	25
8. Counter SC113	25

V. CARE AND MAINTENANCE

CARE AND MAINTENANCE	26
----------------------------	----

VI. SPECIFICATIONS

SPECIFICATIONS	27
----------------------	----

I.

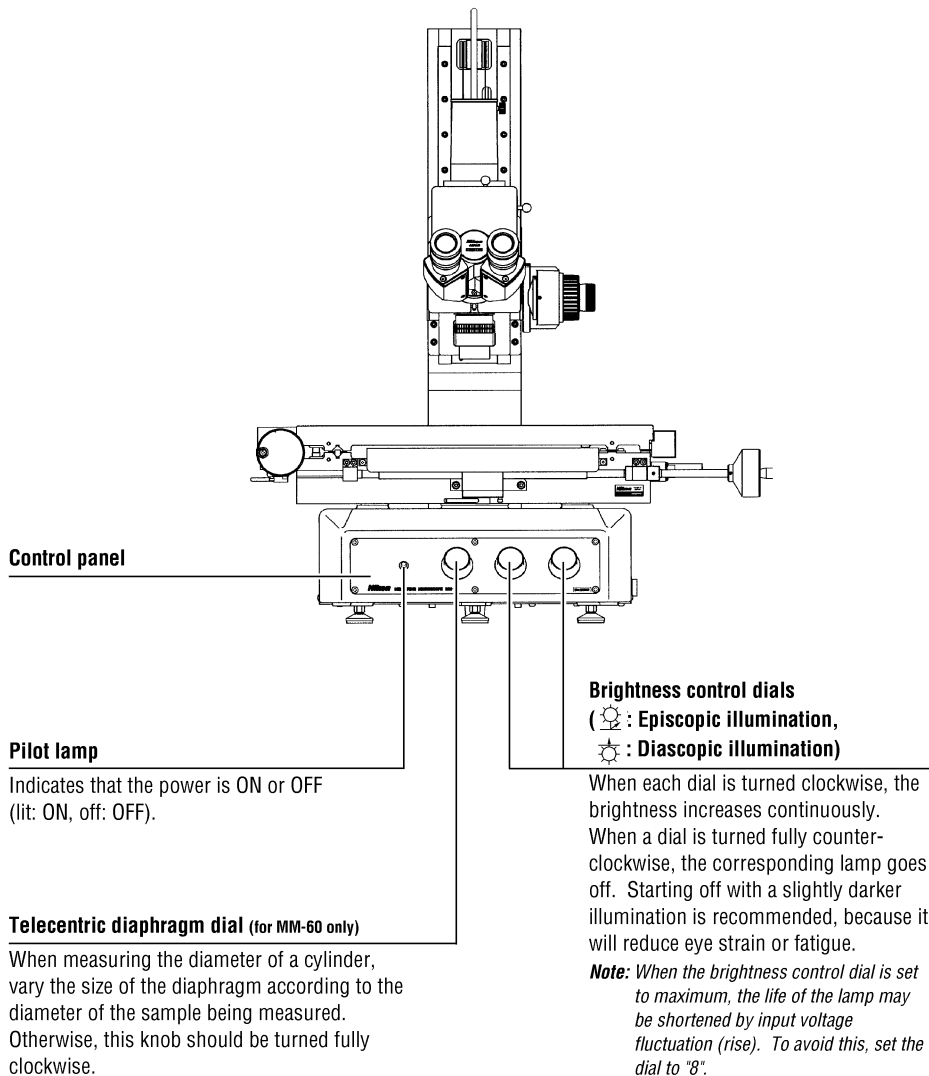
NOMENCLATURE AND FUNCTIONS

Before using the instrument, be sure to read the " ⚠ WARNING", " ⚠ CAUTION" and "Notes on Handling the Instrument" at the beginning of this manual and heed all the instructions written there in. Also be sure to read the instruction manual supplied with the instrument that are used together with this measuring microscope (such as the stage and the lamp).

If you have not yet assembled the microscope, read the chapter "II. Assembly (P. 6)" first.

1. Front view

The illustration shows MM-60.



2. Right-side view

The illustration shows MM-60.

Reticle lever

Pull up to remove cross hairs from the viewfield. Cross hairs can be exchanged with optional concentric circles.

Optical path changeover knob

When this knob is pulled out, light goes to the vertical tube, making it possible to take photomicrographs or use the point sensor. Normally, this knob is pushed in.

Binocular eyepiece tube

Can be replaced with other optional eyepieces.

Eyepiece

Diopter adjustment ring

Stage

(See the instruction manual supplied with the stage.)

Objective

Objectives of magnifying power 1x to 100x are available.

Note: Objectives of magnifying power 20x or higher give their maximum performance when episcopic illumination is used.

Power switch

Turns the power ON and OFF. (| : ON, ○ : OFF)

Vertical tube

The optional photomicrographic attachment or point sensor can be mounted.

Accessory clamp screw

Supporting pillar

Focusing mount

Focus knob

In addition to the 3-stage knob, there are a 2-stage standard knob and a 2-stage fine focusing knob.

Episcopic illuminator

To switch ON, turn the brightness control dial marked ☀ clockwise.

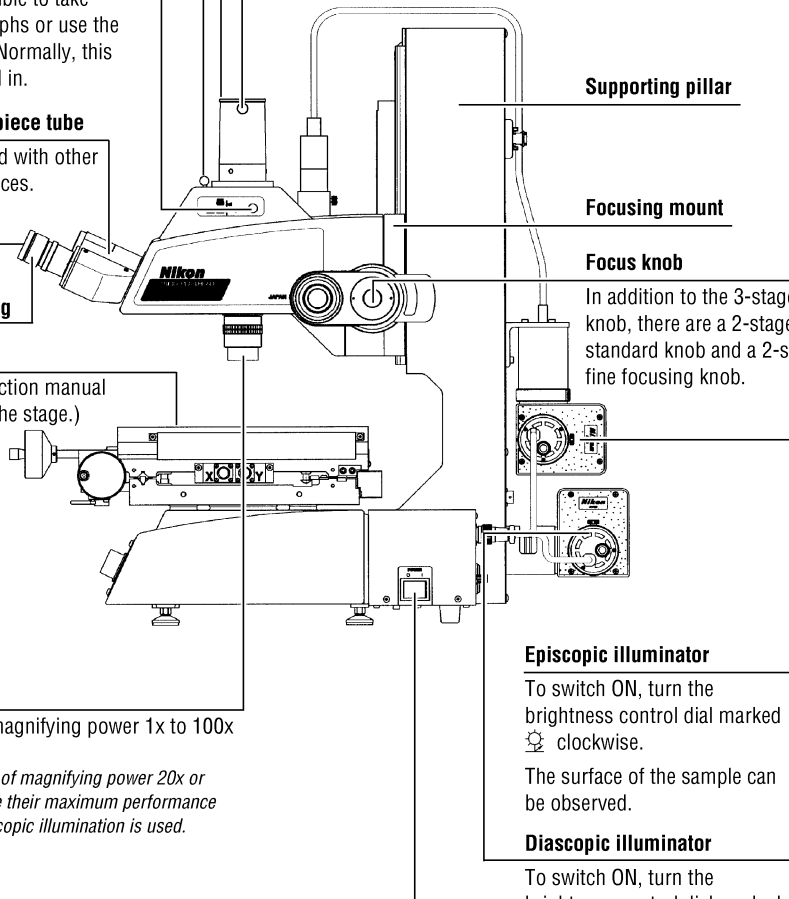
The surface of the sample can be observed.

Diascopic illuminator

To switch ON, turn the brightness control dial marked ☀ clockwise. The contour of the sample image can be observed as a black shadow.

MM-40: 6V-20W

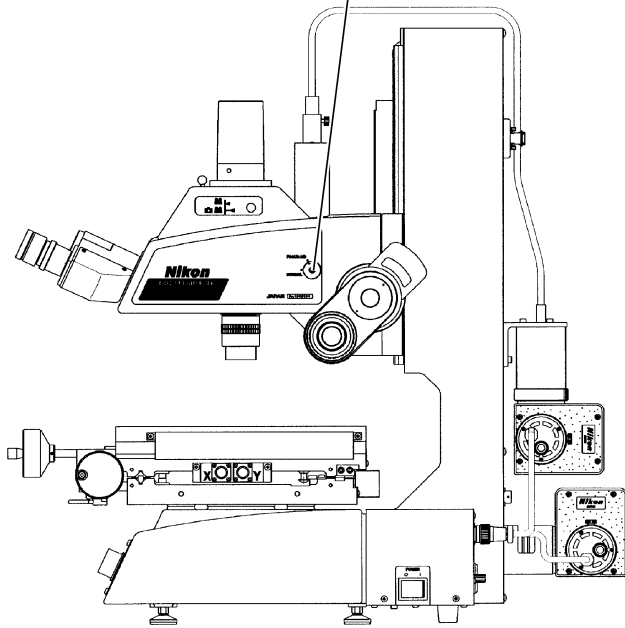
MM-60: 12V-50W



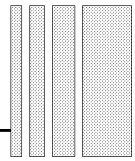
< with trinocular optical head >

Viewfield changeover knob (FOCUS AID / NORMAL)

For focus aid optical head only.



< with focus aid optical head >



3. Rear view

The illustration shows MM-40.

CTRL connector

Connect to external device for brightness control. Equipped on products on and after serial no. 2000000.

Connector for diascope illuminator (DIA)

Connected to the diascope illuminator. Outputs the lamp voltage.

Connector for episcopic illuminator (EPI)

Connected to the episcopic illuminator. Outputs the lamp voltage.

CASE terminal

The frame ground terminal.

Z-axis socket

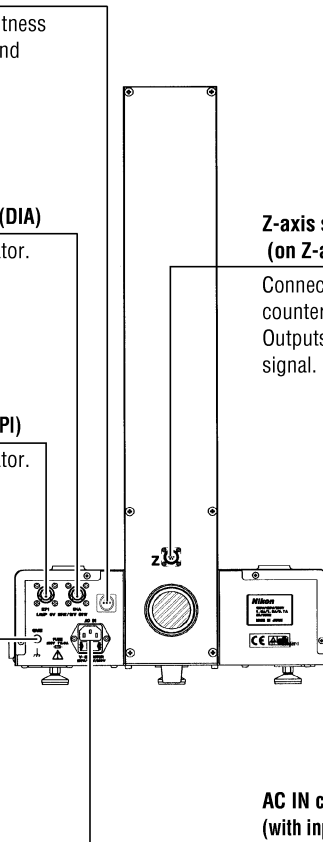
(on Z-axis scale built-in model only)

Connected to the counter unit of the counter SC113, or to "Z-IN" on the SC-111. Outputs the Z-axis (height) linear scale signal.

AC IN connector

(with input voltage selector and fuse holder)

Connected to an AC power supply via the power cord. Turn the power switch OFF before connecting or disconnecting the power cord.



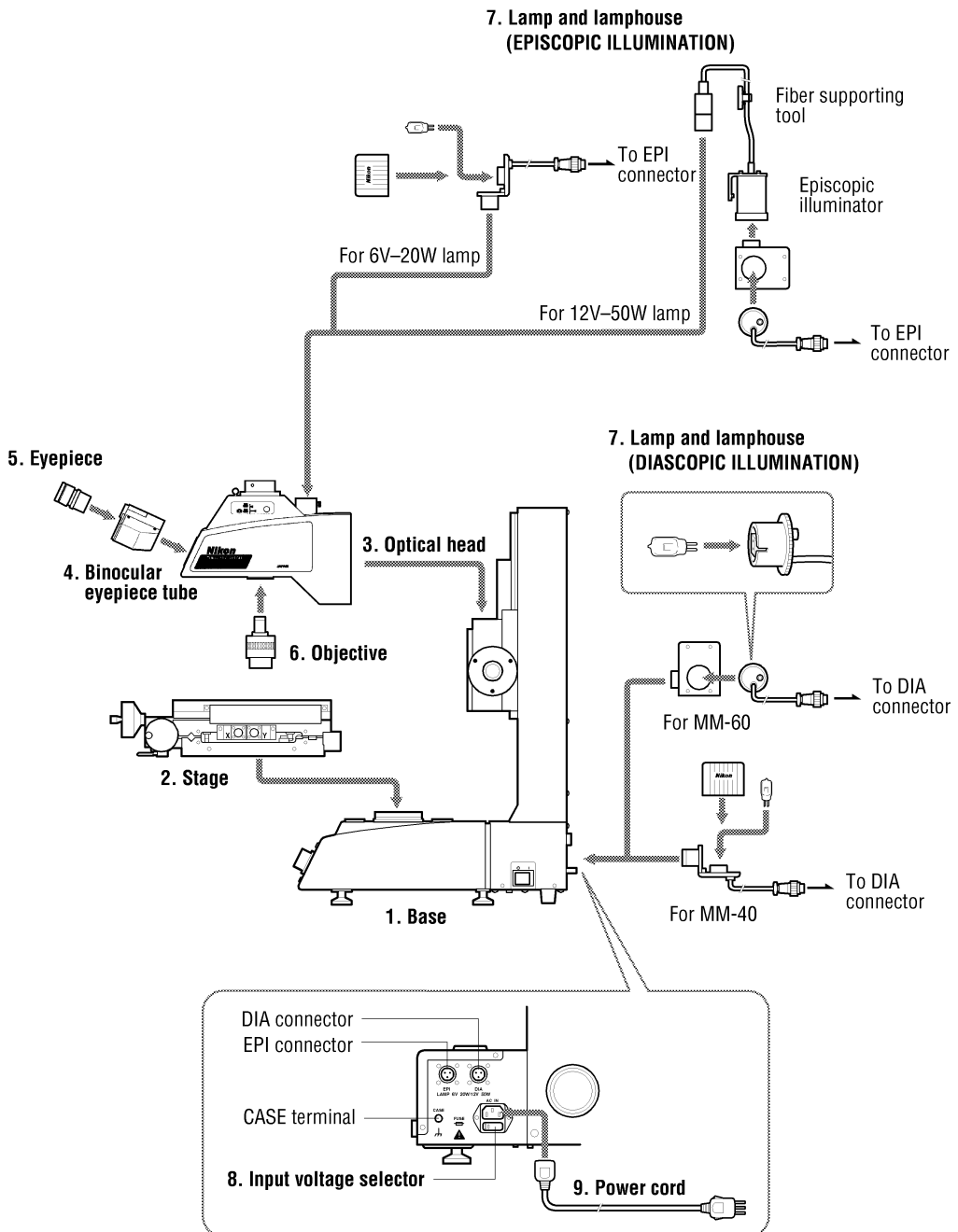
II.

ASSEMBLY

Before assembling the instrument, be sure to read the "**⚠WARNING**", "**⚠CAUTION**" and "**Notes on Handling the Instrument**" at the beginning of this manual and heed all the instructions written there in. Also be sure to read the instruction manual supplied with the instrument that are used together with this measuring microscope (such as the stage and the lamp).

Required tools: Hexagonal screw driver, hexagonal wrench, minus driver

Assemble the instrument by the numbered order. See the following pages for the details on each step.



1. Base

Place the base on a solid table.

Be careful on carrying it since the instrument is very heavy.

Adjust three leveling screws to level the top surface of the base. (Let the auxiliary leg at the rear of the base stay slightly off the table surface).

2. Stage (optional)

Place the stage on the base. Match the centers of the mounting holes on the stage with the centers of the mounting holes on the base. Fix the stage temporarily with four hexagonal socket head bolts and washers. (For details, see the instruction manual supplied with the stage.)

The setting-out adjustment of the stage is necessary after the assembly.

3. Optical head

Attach the optical head to the focusing mount by sliding it down along the dovetail on the mount. When it reaches the limit, equally tighten the two hexagonal socket head screws at the left side.

4. Binocular eyepiece tube

Attach the eyepiece tube to the circular dovetail mount on the optical head, and secure it with a clamp screw using a minus screwdriver.

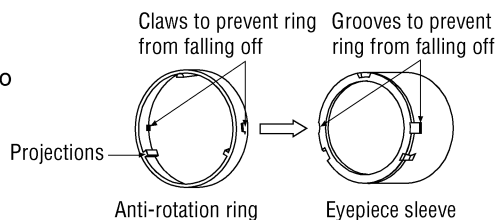
5. Eyepieces

Align three grooves on the eyepiece with the three projections on the binocular eyepiece sleeve and insert. (If old type of eyepieces are to be used, remove the anti-rotation rings from the eyepiece sleeves before inserting the eyepieces to the sleeves.)

An Eyepiece Anti-Rotation Ring

There is an eyepiece anti-rotation ring attached to the eyepiece sleeve. When removing the eyepiece from the sleeve, be careful not to remove this ring together with the eyepiece.

If removed by mistake, press on the ring back to the sleeve directing its two stopper claws toward the sleeve and aligning its two claws and three projections with the grooves on the sleeve.



6. Objective

Attach the objective to the objective mount on the bottom of the optical head.

7. Lamp and lamphouse



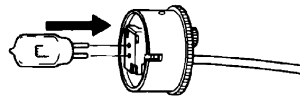
WARNING

- The combination of the lamp and the lamphouse is specified at the Electrical Specifications at the end of this manual. If the other combination is used to light the lamp, fire or malfunction may occur.
- The lamp and the lamphouse become extremely hot when the lamp is on. Be careful not to get yourself burnt. Let it cool for at least 30 minutes after it has been turned off before exchanging the lamp.
- Before attaching the lamp and the lamphouse, turn off the power switch (flip it to the "O" side) and unplug the power cord to prevent electrical shock.
- After exchanging the lamp, make sure that the lamphouse cover is securely closed. Never light the lamp when its cover is open.
- Do not touch the glass bulbs with your bare hands. Finger prints, dirt and scratches on the lamp surface will result in degraded performance, damage to the lamp, and/or a shortened operational life. When handling lamps, either wear gloves or else use a cloth. If a lamp does get dirty, wipe it clean with a cloth moistened with alcohol.

Installing the 12V-50W lamp and the lamphouse

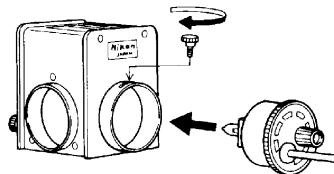
(for episcopic illumination and MM-60 diascopic illumination)

- 1 Plug the lamp into the socket firmly.



Attaching a lamp.

- 2 Attach the socket to the lamphouse and fix it by the socket sleeve
Attaching socket to the lamphouse.



Attaching socket to the lamphouse.

- 3** Attach the lamphouse to the microscope.
When using it for the episcopic illumination, insert into the episcopic illuminator till the limit and fix by the clamp screw.

Attaching the episcopic illuminator to the microscope

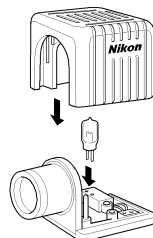
Remove the two, second from the top screws (right and left) holding the rear panel of the microscope and fix the illuminator there using the supplied screws. Attach the fiber supporting tool to the fiber and let it support the fiber at an appropriate position on the microscope pillar. The end of the fiber is to be inserted deep into the episcopic illumination sleeve on the optical head and fixed by the clamp screw.

When using it for diascope illumination, insert into the collector lens barrel at the rear of the base till the limit and fix by the clamp screw. Drop the lemon skin filter into the filter groove nearest to the lamphouse with its matted surface facing toward the base of the microscope. (You can also drop the green filter into the filter groove.)

- 4** Plug in the lamp cord to the rear of the base.
(If the lamphouse is used for the episcopic illumination, plug into the EPI connector. If used for diascope illumination, plug into the DIA connector.)
- 5** When using the lamp for the first time or when you've exchanged the lamp, perform the lamp centering before observation. (p. 12)

Installing the 6V-20W lamp and the lamphouse
(for episcopic illumination and MM-40 diascope illumination)

- 1** Remove the lamphouse cover from the lamphouse.
- 2** Plug the lamp into the socket firmly.
- 3** Replace the cover on the lamphouse aligning it with the split pins.



- 4** Insert the lamphouse into the microscope all the way to the thrusting end and tighten the clamp screw. (If the lamphouse is used for the episcopic illumination, insert it into the mounting sleeve on the optical head. If used for diascope illumination, insert the green filter into the lamphouse and then insert the lamphouse into the collector lens barrel at the rear of the base.)
- 5** Plug in the lamp cord to the rear of the base.
(If the lamphouse is used for the episcopic illumination, plug into the EPI connector. If used for diascope illumination, plug into the DIA connector.)

8. Input voltage selector and fuse

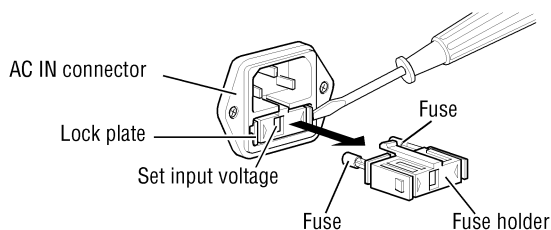


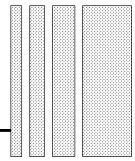
WARNING

- Make sure that the input voltage selector is set to match your local supply voltage. If not, reset the selector according to the instructions below. The use of the instrument with the incorrect input voltage setting will cause shortage that leads to fire, electrical shocks and malfunction. Input voltages that can be set: AC 100V, AC 120V, AC 230V
- Before changing the input voltage selector or fuse, turn off the power switch (flip it to the "O" side) and unplug the power cord to prevent electrical shocks.
- Be sure to use the fuse specified at the Electrical Specifications at the end of this manual. The use of other fuse may lead to fire or malfunction.

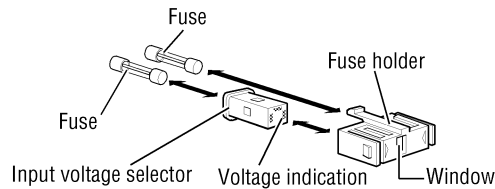
Set the input voltage selector at the rear of the base (near the AC IN connector) so that it matches your local supply voltage.

- 1** Remove the fuse holder from the base using a precision minus driver. (Use the tip of the minus driver to push the two lock plates toward the center of the fuse holder. The fuse holder pops out from the AC inlet.)





- 2** Remove both fuses from the fuse holder.
- 3** Pull out the input voltage selector from the fuse holder.



- 4** Put back the input voltage selector into the fuse holder noting that the voltage indication same as your local supply voltage can be seen through the window on the fuse holder.
- 5** Put back the fuses on the fuse holder.
- 6** Put back the fuse holder to the base.

9. Power cord



WARNING

- Be sure to use the power cord specified at the Electrical Specifications at the end of this manual. The use of other cord may lead to fire or malfunction.
- Before connecting the power cord, turn off the power switch (flip it to the "○" side) to prevent electrical shocks.

Plug the power cord securely into the AC IN connector at the rear of the base. Plug the other end of the cord to the grounded 2-pole outlet.

This completes the assembly.

Before performing the measurement, be sure to read the "**⚠WARNING**", "**⚠CAUTION**" and "**Notes on Handling the Instrument**" at the beginning of this manual and heed all the instructions written there in. Also be sure to read the instruction manual supplied with the instrument that are used together with this measuring microscope (such as the stage and the lamp).

For the correct measurement, be sure to perform the setting-out adjustment of the stage and the lamp centering.

1. Illumination

To light the diascope or the episcopic illumination, turn on the power switch at the side of the base (flip it to the " | " side), and then turn the brightness control dial at the front of the base clockwise. Keep turning the dial clockwise will brighten the illumination. Turning the dial counterclockwise to the limit will turn off the illumination. Holding down the brightness to the extent that you feel it a little dark, will reduce eye strain and prolongs the life of the lamp. (Using the lamp at its maximum brightness may shorten the life of the lamp due to the input voltage fluctuation.) Three types of illumination can be selected on this measuring microscope. Choose the one that best matches your purpose.

- **Diascopic illumination** (☼) :

Enables observation of the contour of the sample as a black shadow.

- **Vertical episcopic illumination** (☼) :

Enables observation of the surface details of the opaque sample.

- **Simultaneous illumination of diascopic and vertical episcopic light:**

Enables observation of both contour and surface of the sample at the same time.

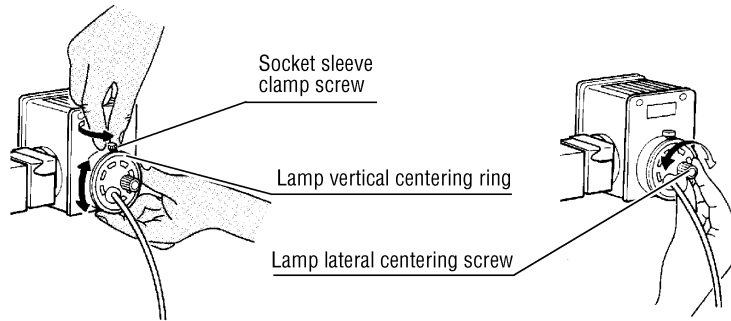
(If you turn on an illuminator while the other illuminator has already been turned on, the brightness of the illuminator that was originally turned on automatically decreases. This is not a sign of malfunction. If more intensity is needed, adjust the brightness control dial.)

If the 12V-50W lamphouse is used, be sure to perform the lamp centering before observation and measurement.

Centering the 12V-50W lamp (for diascopic illumination)

- 1 Turn on the power switch of the measuring microscope (flip it to the " | " side). Turn on the diascopic illumination by turning the brightness control dial clockwise.

- 2** Place a sheet of white paper on the stage. Adjust the lamp lateral centering screw and the lamp vertical centering ring so that the light spot becomes round and of uniform intensity. (Loosen the socket sleeve clamp screw when turning the lamp vertical centering ring.)



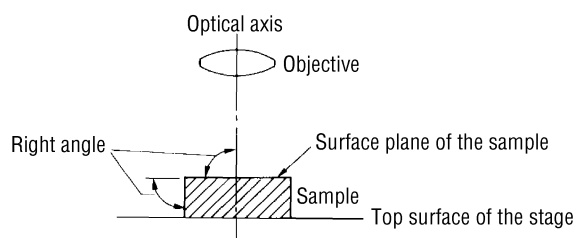
Centering the 12V-50W lamp (for episcopic illumination)

- 1** Attach the 3x objective to the optical head.
- 2** Turn on the power switch of the measuring microscope (flip it to the "I" side). Turn on the episcopic illumination by turning the brightness control dial clockwise. (The diascope illumination should be turned off.)
- 3** Place a sheet of white paper on the stage and focus on the paper. Adjust the lamp lateral centering screw and the lamp vertical centering ring so that the light spot from the objective becomes round and of uniform intensity. (Loosen the socket sleeve clamp screw when turning the lamp vertical centering ring.)

2. Setting the sample

Place a sample on the stage in such a position that its surface plane is perpendicular to the optical axis of the objective. If not, uniform focusing will not be obtained over the entire viewfield.

Since the top surface of the stage is made perpendicular to the optical axis, the sample with parallel top and bottom surfaces can just be placed on the stage.



3. Focusing

Refer to the chapter "5. Using the focus knobs" for the details on how to use the focus knob.

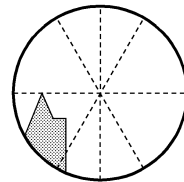
- 1** Turn the diopter adjustment ring on the eyepiece to focus on the reticle image (lines that can be seen when you look into the eyepiece, such as cross hairs).
- 2** Rotate the coarse focus knob to move the focusing mount vertically so that the distance between the sample and the upper thrusting end of the objective is just about 126 mm. (Watch the clearance between the objective end and the sample while rotating the coarse focus knob so that the objective end will not hit the sample. Regardless of the objective magnification, the focus plane of the objective is 126 mm below the thrusting end of the objective.)
- 3** Look into the eyepiece and rotate the fine focus knob to focus precisely on the sample image. (Note 1)
- 4** Check that the image is correctly focused.
 - 4-1** Look into the eyepiece. While gazing on the reticle image, move your head laterally and vertically and see if the sample image moves away from the reticle image. If so, the microscope is not focused correctly. (This situation is often referred to as the "existence of a parallax error".)
 - 4-2** If the parallax error exists, adjust the focusing as follows; Once again gaze on the reticle image and move your head. If the sample image shifts in the same direction as your head, move the optical head nearer to the sample. If the sample image moves against your head, move the optical head away from the sample.

Note 1: Since higher magnification objectives have shorter working distances (= W.D. = the distance between the objective end and the focal plane), you may hit the sample with the objective end during focusing. To avoid this accident, first lower the optical head while observing the clearance between the objective and the sample, and then focus on the image by raising the optical head from the point slightly lower than the W.D. of the objective.

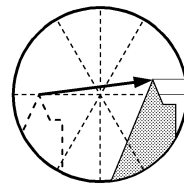
4. Setting-out adjustment of the stage

Turn on the diasopic or episcopic illumination and look into the eyepiece. You should see the cross hairs in the viewfield. To perform the correct measurement, the mounting position of the stage should be adjusted so that the direction of the stage travel becomes absolutely the same with the direction of the cross hairs. (Since the three of the four mounting holes on the stage is made larger than the size of the mounting bolts, the stage can be swiveled around the mounting bolt at the left back of the stage.)

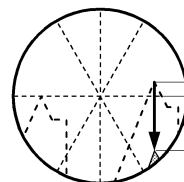
- 1** Attach the 3x objective to the optical head. Place a sample on the stage.
- 2** Turn on the power switch of the measuring microscope (flip it to the " | " side). Turn the brightness control dial clockwise to turn on the diasopic or episcopic illumination.
- 3** Focus on the sample.
- 4** Travel the stage and match a distinct point on the sample (such as an apex) with the cross hairs.
- 5** Travel the stage in the x-direction and check that the distinct point does not move away from the cross hairs. If it does, swivel the stage around the mounting bolt at the left side back so that the distinct point on the sample moves five times away in the opposite direction as the first deviation.
- 6** Repeat the steps 4 and 5 till the sample image stays with the cross hairs even though the stage is moved. When 3x objective is used, the deviation of the image should be held down to below 0.01 mm (the thickness of the dotted line in the viewfield). Tighten the stage mounting bolts after the adjustment.



Match a distinct point on the sample with the cross hairs.



By the lateral stage travel, the distinct point has moved away from the cross hairs.



Swivel the stage so that the distinct point moves five times away in the opposite direction.

Swivel center.

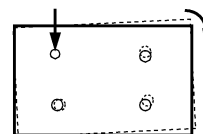


Image of the stage swivel.

5. Using the focus knob

The measuring microscope you've purchased should have one of the following focus knobs: "3-stage focus knob", "2-stage normal focus knob" or "2-stage fine focus knob". Since these knobs differ in their way of using, please read the part that matches your microscope. If you wish to have the focus knob at the left side of the microscope, contact your nearest Nikon representative.

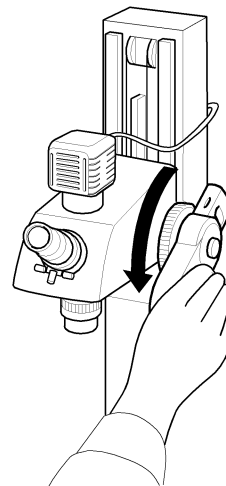
If you are to adjust the rotation torque of the coarse focus knob, be careful not to over loosen it since the optical head will fall on its own weight.

3-stage focus knob

Can be used conveniently when you need to move the optical head in a large span. When rotating the coarse focus arm, hold the intermediate focus knob or the arm itself as shown in the drawing. Be sure to keep your eyes off the eyepiece while rotating the coarse focus arm. For the focusing that follows, the arm should be stopped at the position where the intermediate or fine focus knobs can be used with ease (use the HOLD knob).

It may be easy for you to find the focal plane by holding the intermediate focus knob and lightly swinging the coarse focus arm.

The rotation torque of the coarse focus arm and the intermediate focus knob can be adjusted separately.



The amount the optical head is moved per rotation

Coarse focus arm:	About 32 mm / rev. (About 28.5 mm / rev. when the arm is turned with intermediate focus knob held.)
Intermediate focus knob:	About 3.5 mm / rev.
Fine focus knob:	About 0.2 mm / rev.

HOLD mechanism of the coarse focus arm (rotation clamp)

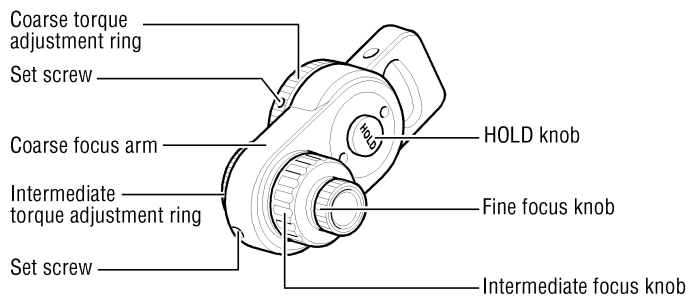
The 3-stage focus knob has a mechanism that holds (fixes) the coarse focus arm in place so that it cannot be turned carelessly. Tightening the HOLD knob at the center of the arm (turning it all the way clockwise) fixes the arm in place. To avoid malfunction, do not turn the coarse focus arm while it is fixed by the HOLD knob (while the HOLD knob is turned all the way clockwise). When you don't need to fix the arm in place, be sure to loosen the HOLD knob (turn it all the way counterclockwise).

Rotation torque adjustment of the coarse focus arm

Loosen the two set screws fixing the coarse torque adjustment ring and rotate the ring to change the rotation torque of the coarse focus arm. Be careful not to over loosen the ring to avoid the optical head falling down on its own weight. (The rotation torque of the coarse focus arm is factory adjusted so that the normal type optical heads will not fall down on its own weight.)

Rotation torque adjustment of the intermediate focus arm

Loosen a set screw fixing the intermediate torque adjustment ring and rotate the ring to change the rotation torque of the intermediate focus knob.



2-stage normal focus knob

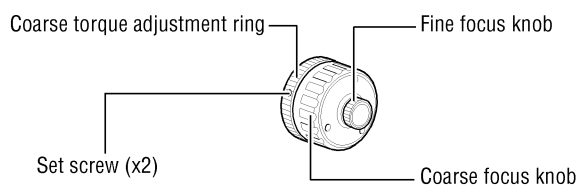
2-stage normal focus knob is made up of coarse and fine focus knobs. The fine focus knob is designed so that the amount the optical head is moved is suitable for the objectives of low magnification (1x to 50x). The rotation torque of the coarse focus knob can be adjusted.

The amount the optical head is moved per rotation

- Coarse focus knob: About 32 mm / rev.
- Fine focus knob: About 0.5 mm / rev.

Rotation torque adjustment of the coarse focus knob

Loosen the two set screws fixing the coarse torque adjustment ring and rotate the ring to change the rotation torque of the coarse focus knob. Be careful not to over loosen the ring to avoid the optical head falling down on its own weight. (The rotation torque of the coarse focus knob is factory adjusted so that the normal type optical heads will not fall down on its own weight.)



2-stage fine focus knob

Every characteristics of this focus knob is the same as the 2-stage normal focus knob except the amount the optical head is moved by the fine focus knob. The fine focus knob is designed so that the movement of the optical head will be suitable for the objectives of high magnification (more than 10x).

The amount the optical head is moved per rotation

Coarse focus knob: About 32 mm / rev.

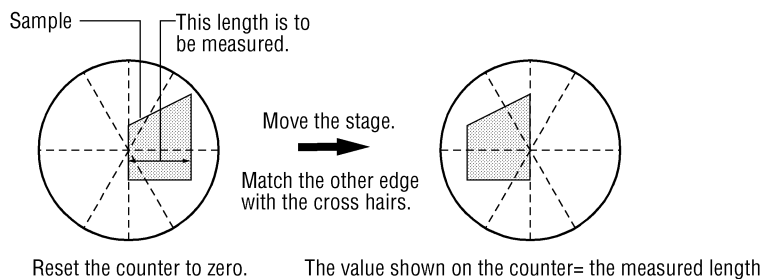
Fine focus knob: About 0.15 mm / rev.

6. Examples of measurement

Measurement of the length (the distance between two parallel edges)

Using the optional stage and the counter that evaluates the amount the stage is moved, you can measure the distance between two parallel edges. Before the measurement, be sure to perform the setting-out adjustment of the stage.

- 1 Align one edge of the sample with the cross hairs in the viewfield. Adjust the position of the sample so that the edge will be parallel against the cross hairs.
- 2 Reset the counter to zero. (Press both the X and Y axis counter reset switches.)
- 3 Move the stage and match the other edge of the sample with the same cross hairs.
- 4 The value shown on the counter is the measured length (the distance between two edges).



- ▶ When using the focus aid optical head, set the viewfield changeover knob to "NORMAL" during the measurement.

**Measurement of cylinder and sphere diameters
(for MM-60 only)**

1 Place the sample parallel against the moving direction of the stage. The use of optional tilting center fixture or other devices may be convenient for this procedure.

2 Decide the diameter of the telecentric diaphragm from the diameter of the sample.

Günther's empirical formula $D = 0.18F (1/d)^{1/3}$

D: Diameter of telecentric diaphragm

d: Diameter of sample

F: Focal distance of collimator lens

Table 1 Relationships between D and d by Günther's empirical formula

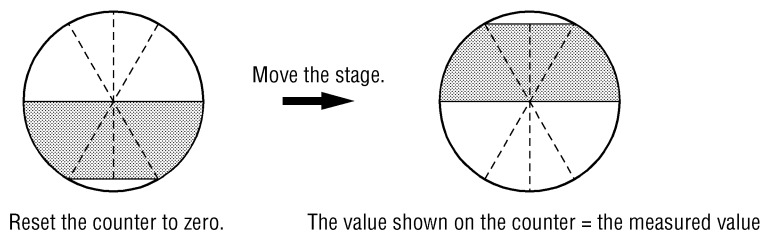
dmm	Dmm	dmm	Dmm	dmm	Dmm	dmm	Dmm
1	14.4	8	7.2	20	5.3	60	3.7
2	11.4	9	6.9	25	4.9	70	3.5
3	10.0	10	6.7	30	4.6	80	3.3
4	9.1	12	6.3	35	4.4	90	3.2
5	8.4	14	6.0	40	4.2	100	3.1
6	7.9	16	5.7	45	4.0	150	2.7
7	7.5	18	5.5	50	3.9	200	2.5

According to Günther, good results can be obtained when the above empirical formula is satisfied. Thus, setting the telecentric diaphragm according to Table 1 is recommended as long as there is no special reason. Since it is very difficult to precisely distinguish half-shadowed areas when measuring a sample such as a sphere or cylinder, we recommend that you perform a calibration with a contact-type measuring instrument.

3 Align one side (contour) of the sample with the cross hairs in the viewfield. Reset the counter to zero.

4 Move the stage and align the other side (contour) of the sample with the same cross hairs.

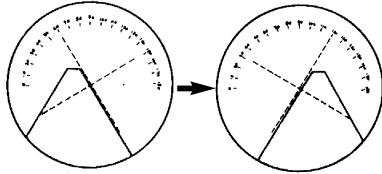
5 The value shown on the counter is the measured value (the diameter of the sample).



Measurement of the angle

Using the optional 10' or 1' reading protractor eyepiece, you can measure the angle of the sample.

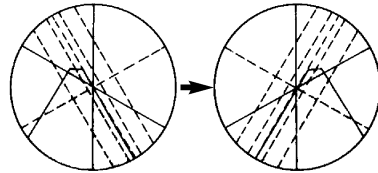
Viewfield of the 10' reading protractor eyepiece



Viewfield of the 1' reading protractor eyepiece



(Viewfield of angle reading eyepiece)



(Viewfield of observing eyepiece)

- 1** Remove the binocular eyepiece tube from the optical head and mount the protractor eyepiece instead with monocular eyepiece adapter.
 - 2** Pull up the reticle lever on the top of the optical head to remove the cross hairs from the viewfield.
 - 3** Align one side of the sample with the cross hairs or the 60° line. Read the protractor.
 - 4** Rotate the protractor and align the other side of the sample with the same cross hairs or 60° line. Read the protractor.
 - 5** The difference between the two protractor readings is the measured angle.
 - If you are to measure a large angle, it is efficient to use the cross hairs as the standard for 90° and read the difference. (The 1' reading protractor eyepiece permits the same way of measurement using 30°, 60°, or 120° lines.)
 - Rapid measurement can be achieved with the use of stage movement since there is no need to coincide the apex of an angle with the center of the cross hairs (viewfield).
 - Making a narrow, parallel clearance between the sample image and the cross hairs will improve the accuracy of the measurement.
 - Setting-out adjustment of the sample is necessary to perform angular and length measurements at the same time.
 - 6** After the angular measurement, when the binocular eyepiece tube is attached, press the reticle lever down until it stops.
- ▶ When using the focus aid optical head, set the viewfield changeover knob to "NORMAL" during the measurement.

Measurement of the height (for Z-axis scale built-in models only)

If your measuring microscope has a built-in Z-axis scale, you can measure the height of the sample by connecting the optional counter to the Z-axis socket at the rear of the measuring microscope.

When using the trinocular optical head:

Use an objective of 20x or higher magnification. An accurate measurement cannot be made with a lower magnification objective since its depth of focus will be larger than the higher magnification objectives and thus the image will be focused in wider range.

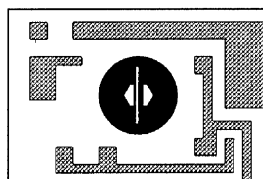
- 1 Focus accurately on a part of the sample that will be the standard for the height measurement.
- 2 Reset the Z-axis counter to zero. (Press the counter Z-axis reset switch.)
- 3 Move the stage to place the part of the sample to be measured within the viewfield. Focus accurately on it.
- 4 Read the counter value.
Value shown on the counter = the measured height

When using the focus aid optical head:

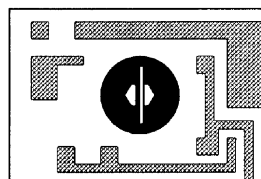
The objective of 5 to 50x magnification can be used, but for obtaining high repeatability in focusing accuracy, use of 20x or 50x objective is recommended.

Depending on the condition of the sample surface, repeatability of focusing accuracy may be degraded as focus aid patterns sometimes become difficult to observe.

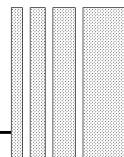
- 1 Rotate the viewfield changeover knob to the "FOCUS AID" side all the way until it stops.
- 2 Place a part of the sample that will be the standard for the height measurement. Turn the focus knobs to search the focus plane. When the sample is nearly in focus, the focus aid patterns will be shown in the viewfield. If the sample is front focused, the patterns will be as in Fig. (a), and if rear focused, they will be as in Fig. (b).



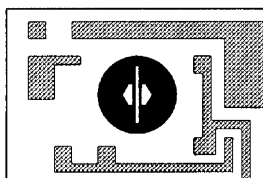
(a) Front focused



(b) Rear focused



- 3 Turn the focus knob until the focus aid patterns become symmetrical as shown in Fig. (c). (The sample is in focus when the focus aid patterns become symmetrical.)



(c) In focus

- 4 Reset the Z-axis counter to zero. (Press the counter Z-axis reset switch.)
- 5 Move the stage to place the part of the sample to be measured within the viewfield.
- 6 Use the focus aid patterns to focus on the sample. (Turn the focus knobs till the focus aid patterns become symmetrical.)
- 7 Read the counter value.
Value shown on the counter = the measured height

IV.

OPTIONAL ACCESSORIES

1. 10' reading protractor eyepiece

The 10' reading protractor eyepiece with monocular eyepiece adapter is mounted in place of the standard binocular eyepiece tube.

This eyepiece has cross hairs and a protractor in its viewfield. Turning the protractor ring will rotate the cross hairs together with the vernier by 180°, permitting measurement of angles with the cross hairs as its standard.

2. 1' reading protractor eyepiece

The 1' reading protractor eyepiece with monocular eyepiece adapter is mounted in place of the standard binocular eyepiece tube.

This eyepiece has a small angle reading eyepiece in addition to the observing eyepiece. Turning the micrometer knob on the back will rotate the vernier together with the cross hairs in the viewfield of the observing eyepiece. This permits measurement of angles with the cross hairs as its standard in the same way as with the 10' reading protractor eyepiece. (The angle can be read through the angle reading eyepiece.) There is an illuminating mirror on the back of the angle reading eyepiece. Adjust the direction and inclination of the mirror to obtain the brightest viewfield.

3. Concentric circles (reticle)

The concentric circles reticle is to be mounted instead of the standard cross hairs reticle.

The concentric circles reticle is to be used in combination with the 3x objective. It can be used to measure the diameters of small circles as well as their center coordinates.

- 1** Loosen the screws to remove the panel with "RETICLE" indication at the upper part of the optical head.
- 2** Remove the knurled nut inside and pull up the reticle lever to remove the standard cross hairs reticle from the optical head.
- 3** Screw off the standard reticle from the reticle lever and screw on the concentric circles reticle instead.
- 4** Insert the concentric circles reticle in the optical head, fasten the knurled nut, and attach the panel.
- 5** Press down the reticle lever as far as it goes to place the concentric circles in the viewfield.

4. Stages

The stages permit minute movement of the sample and to read out the amount of travel. Choose the most appropriate stage depending on the sample to be measured.

● **Stages that can be used with the MM-40:** 2x2, O3L, 4x4, 6x4

● **Stages that can be used with the MM-60:** 2x2, O3L, 4x4, 6x4, 8x6

Each stage has linear encoders inside, and when connected to a counter, X and Y coordinates can be read. The minimum reading is 0.0005mm. For further details, read the instruction manual supplied with each stage.

Table 2

(Unit: mm)

Stage	2x2	O3L	4x4	6x4	8x6
Stage dimensions (L x W)	ϕ 174	285 x 192	285 x 240	350 x 240	400 x 280
Stage glass dimensions (L x W)	ϕ 107	170 x 120	170 x 145	204 x 145	245 x 192
Stroke (L x W)	50 x 50	100 x 50	100 x 100	150 x 100	200 x 150
Maximum load (kg)	5	5	6	15	15

5. Point sensor

The point sensor is used to automatically detect the edges of the samples.

Please refer to the instruction manual supplied with the point sensor for details.

- 1 Remove the cap on the vertical tube of the optical head.
- 2 Insert the point sensor adapter (A2 or B2) into the vertical tube until its thrusting end touches the vertical tube, and fix it by the clamp screw.
- 3 Center the adapter using the positioning eyepiece.
- 4 Attach the point sensor to the adapter.

6. TV camera adapter

The TV camera adapters should be mounted on the vertical tube (first remove the cap on the vertical tube).

- ① TV camera adapter with cross hairs:

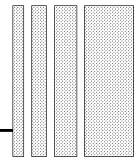
See the instruction manual supplied with the adapter for details.

- ② C-mount TV adapter:

Insert the PL projection lens into the vertical tube first, and then the adapter.

- ③ Direct C-mount adapter:

Remove the upper half of the vertical tube by loosening the screws. Insert the adapter to the remaining half of the vertical tube.



7. Ring illumination

Ring illumination such as the Ring fiber illuminator or the Fluorescence illuminator can be used by attaching the external illumination adapter to the objective mount on the optical head. See the instruction manual supplied with the illuminators for details.

8. Counter SC113

(Measurement of Z-axis movement can be performed only on Z-axis scale built-in models.)

- 1** Remove three screws holding the circular plate at the opposite side of the focus knob, then remove the circular plate.
- 2** Attach the display unit of the SC113 instead of the circular plate.
- 3** Using the supplied cord, connect the display unit to the DISPLAY socket on the counter unit.
- 4** Plug X and Y cords of the stage into the X-IN and Y-IN sockets on the counter unit.
- 5** Using the cord provided with the microscope base, connect the Z socket on the rear of the base to the Z-IN socket on the counter unit.

1. Lens cleaning

Dust is best removed with a soft brush or gauze. More persistent dirt, such as fingerprints, grease and oil, may be removed with soft cotton, lens tissue, or gauze lightly moistened with absolute alcohol (methyl alcohol or ethyl alcohol.) Do not try to clean the inner part of the measuring microscope. Ask your nearest Nikon representative instead.

Absolute alcohol is quite inflammable. Use great care when handling it and when setting the power switch on and off. Be very careful with fire.

2. Cleaning painted or plastic surfaces

The use of silicon cloth is recommended to clean the painted or plastic components. For persistent dirt, dampen a piece of gauze with diluted neutral detergent and wipe lightly. Do not use organic solvents such as alcohol, ether, or paint thinner. Doing so could cause fading or discoloration. The printed parts on the plastic components should only be wiped with a piece of cloth dampened with water.

3. Protection against dust

Always take care to protect the measuring microscope from the dust, especially the sliding surfaces of the stage and the focusing mount guide. When not using the microscope, protect it from dust with a vinyl cover or the like.

4. Oiling

With normal use, oiling of the focusing mount guide and the rack will not be necessary for a long time. If oiling should become necessary, use a lubricant such as Nippon Sekiyu Epi-Knock Grease AP-0.

5. Lenses

To obtain a bright sharp image, always keep the lenses clean, including the eyepiece and the objectives.

1. Optical head

Image: Upright and not laterally inverted

Eyepiece tube: Binocular, 25° depression

2. Eyepiece

Magnification: 10x

Diopter adjusting range: -8 to $+5\text{m}^{-1}$ (-8 to $+5$ diopters)

3. Objectives

Table 3

Magnifying power	Real viewfield mm	N.A.	Depth of focus μm	Working distance (W.D.) mm	Weight g	Accuracy of magnification %
1X	$\phi 20$	0.03	782	79	120	± 0.1
3X	$\phi 6.6$	0.09	87	75.5	150	± 0.1
5X	$\phi 4$	0.13	38	64	150	± 0.1
10X	$\phi 2$	0.2	14	49.5	200	± 0.1
20X	$\phi 1$	0.4	3.5	20.3	650	± 0.15
50X	$\phi 0.4$	0.55	1.4	15.1	600	± 0.3
100X	$\phi 0.2$	0.75	0.7	4.1	550	± 0.5

Mounting screw: M26x0.75

Distance from objective lens thrusting end to the image: 200mm

Distance from objective lens thrusting end to the sample: 126mm

4. Accuracy of total magnification

Same as that of the objectives in the center 1/2 of viewfield

5. Vertical travel range

(1) Range

MM-40: 150mm

MM-60: 200mm

(2) Moving speed (per rotation of knob):

3-stage focus knob

Coarse focus: approx. 32mm/rev.

Medium focus: approx. 3.6mm/rev.

Fine focus: approx. 0.2mm/rev.

2-stage normal focus knob

Coarse focus: approx. 32mm/rev.

Fine focus: approx. 0.5mm/rev.

2-stage fine focus knob

Coarse focus: approx. 32mm/rev.

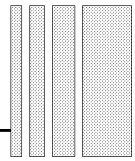
Fine focus: approx. 0.15mm/rev.

6. Supporting pillar

Shape: Rectangular section type.

7. Electrical Specifications

Input rating	Switchable through the voltage selector. Listed below are the three voltages that can be set. 100V AC, 50 / 60Hz, 1.5A 120V AC, 50 / 60Hz, 1.3A 230V AC, 50 / 60Hz, 0.7A
Voltage fluctuation	±10%
Fuse ratings	For 100 / 120V regions: Two time lag fuses 250V / 2.5A (Must be UL-listed fuses.) For 230V regions: Two time lag fuses 250V / 2.5A (Must be approved by SEMCO.)
Lamp and lamphouse for diasopic illumination	For MM-40: Lamp ratings: 6V-20W halogen lamp Lamphouse: Nikon halogen lamphouse 6V-20W For MM-60: Lamp ratings: 12V-50W halogen lamp Lamphouse: Nikon halogen lamphouse 12V-50W (Model LHS-H50C-1)
Lamp and lamphouse for episcopic illumination	When 6V-20W lamp is used: Lamp ratings: 6V-20W halogen lamp Lamphouse: Nikon halogen lamphouse 6V-20W When 12V-50W lamp is used: Lamp ratings: 12V-50W halogen lamp Lamphouse: Nikon halogen lamphouse 12V-50W (Model LHS-H50C-1)



Operating environment	Altitude: 2000m max. Temperature: 0 to 40° C (This product is made to exhibit optimum performance at 20°C.) Relative humidity: 70% max., with no condensation Pollution: Degree 2
Protection class	Class I
Installation	Category II
Power cord	Use only the following power supply cord. Using the wrong power cord could result in danger or fire. The protection Class I equipment should be connected to PE (protective earth) terminal. For 100 / 120V regions: UL-listed detachable power cord set, three-conductor grounding Type SVT, No. 18 AWG, 3m long maximum, rated at 125V AC minimum. For 230V regions: Approved according to EU/EN-standards, 3 conductor grounding Type H05VV-F, 3m long maximum, rated at 250V AC minimum
Conforming standards	GS approved product EU Low Voltage Directive satisfied EU EMC Directive satisfied



NIKON CORPORATION / 株式会社 ニコン

2-3, Marunouchi 3-chome, Chiyoda-ku, Tokyo 100-8331, Japan
〒100-8331 東京都千代田区丸の内 3-2-3 (富士ビル)

NIKON INSTECH CO., LTD. / 株式会社 ニコン インステック

Parale-Mitsui Bldg., 8, Higashida-cho, Kawasaki-ku, Kawasaki, Kanagawa, 210-0005 Japan	TEL +81-44-223-2161	FAX +81-44-223-2182
本社 210-0005 川崎市川崎区東田町 8 番地 パレール三井ビルディング 13 階	電話 (044) 223-2160	FAX (044) 223-2180
札幌営業所 001-0011 札幌市北区北 11 条西 4-1-40 (すばるビル)	電話 (011) 746-9381	FAX (011) 746-9398
名古屋営業所 460-0002 名古屋市中区丸の内 3-20-17 (中外東京海上ビル)	電話 (052) 954-0165	FAX (052) 954-0166

●系列会社●

株式会社コーガク【大阪(本社)、京都、金沢】

本社 532-0003 大阪市淀川区宮原 3-3-31 上村ニッセイビル 16 階	電話 (06) 6394-8801
京都支社 606-8221 京都市左京区田中西樋ノ口町 80	電話 (075) 781-1170

株式会社大熊商会【福岡(本社)、北九州、長崎、大分、熊本、宮崎、国分、鹿児島】

本社 813-0034 福岡市東区多の津 1-4-1	電話 (092) 611-1111
----------------------------	-------------------

NIKON INSTRUMENTS INC.

1300 Wait Whitman Road, Melville, NY 11747-3064, U.S.A.
Tel: +1-631-547-8500 Fax: +1-631-547-0306

NIKON INSTRUMENTS EUROPE B.V.

Schipholweg 321, P.O. Box 222, 1170 AE Badhoevedorp, The Netherlands
Tel: +31-20-44-96-222 Fax: +31-20-44-96-298

