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INSTRUCTIONS FOR
160 SERIES
COMPOUND BIOLOGICAL MICROSCOPES

INTRODUCTION

Thank you for your purchase of a National microscope. It is a well built, precision instrument carefully checked to assure that it reaches you in good condition. It is designed for ease of operation and years of carefree use. The information in this manual probably far exceeds what you will need to know in order to operate and maintain your microscope. However, is provided to answer questions which might arise, and to help you avoid any maintenance expense that may be unnecessary.

Your new compound microscope is a high performance microscope with high quality Achromatic objective lenses that provide good resolution and optical centering. The microscope is designed with a built-in ball bearing mechanical stage providing a travel range of 70mm x 50mm in the X and Y direction with graduation reading up to 0.1mm for accurate positioning of specimen. Also included is a ball bearing quadruple nosepiece, precision coaxial focusing mechanism, rack and pinion mounted N.A. 1.25 Abbe condenser and built-in 12 volt 20 watt halogen variable light source.

Carefully read these instructions before operating microscope. They will permit you to use your new microscope to its fullest capability. Nomenclature used to describe components and controls is identified by referring to diagram on page 2.

I. UNPACKING

The microscope and accessories have been carefully packed to assure they reach you in the best possible condition. Do not discard packing container or materials until all components are accounted for. Save packing container in case microscope needs transporting to another location or shipped for repairs. Components are packed within two styrofoam containers; A and B as indicated below.

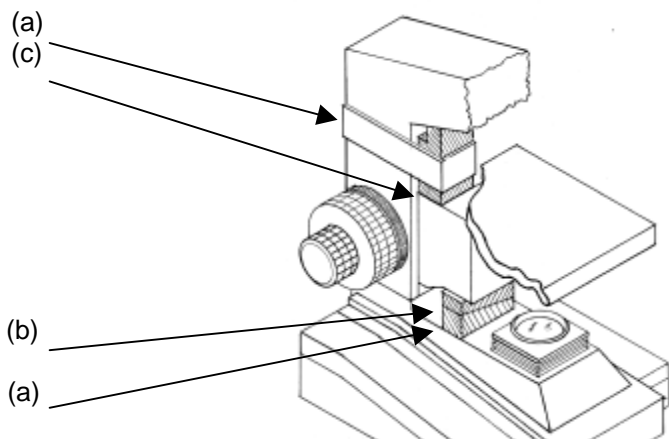
- | | |
|---------------------|--|
| 160 Monocular: | (A) Stand
(B) Head, one eyepiece, one rubber eyeshield, four objectives, condenser, specimen holder, 32mm blue, yellow and green filters, 45mm neutral filter, spare fuse, dust cover. |
| 161 Dual head: | (A) Stand
(B) Head, vertical viewing eyepiece tube, two eyepieces, two rubber eyeshields, four objectives, condenser, specimen holder, 32mm blue, yellow and green filters, 45mm neutral filter, spare fuse, dust cover, 2mm "L" type key wrench. |
| 162 Binocular head | (A) Stand
(B) Head, two eyepieces, two rubber eyeshields, four objectives, condenser, specimen holder, 32mm blue, yellow and green filters, 45mm neutral filter, spare fuse, dust cover. |
| 163 Trinocular head | (A) Stand
(B) Head, three eyepieces, three rubber eyeshields, four objectives condenser specimen holder, 32mm blue, yellow and green filters, 45mm neutral filter, spare fuse, dust cover.
(C) Vertical viewing eyepiece tube |

- A. Lay styrofoam container (A) flat and carefully remove microscope stand.

NOTICE

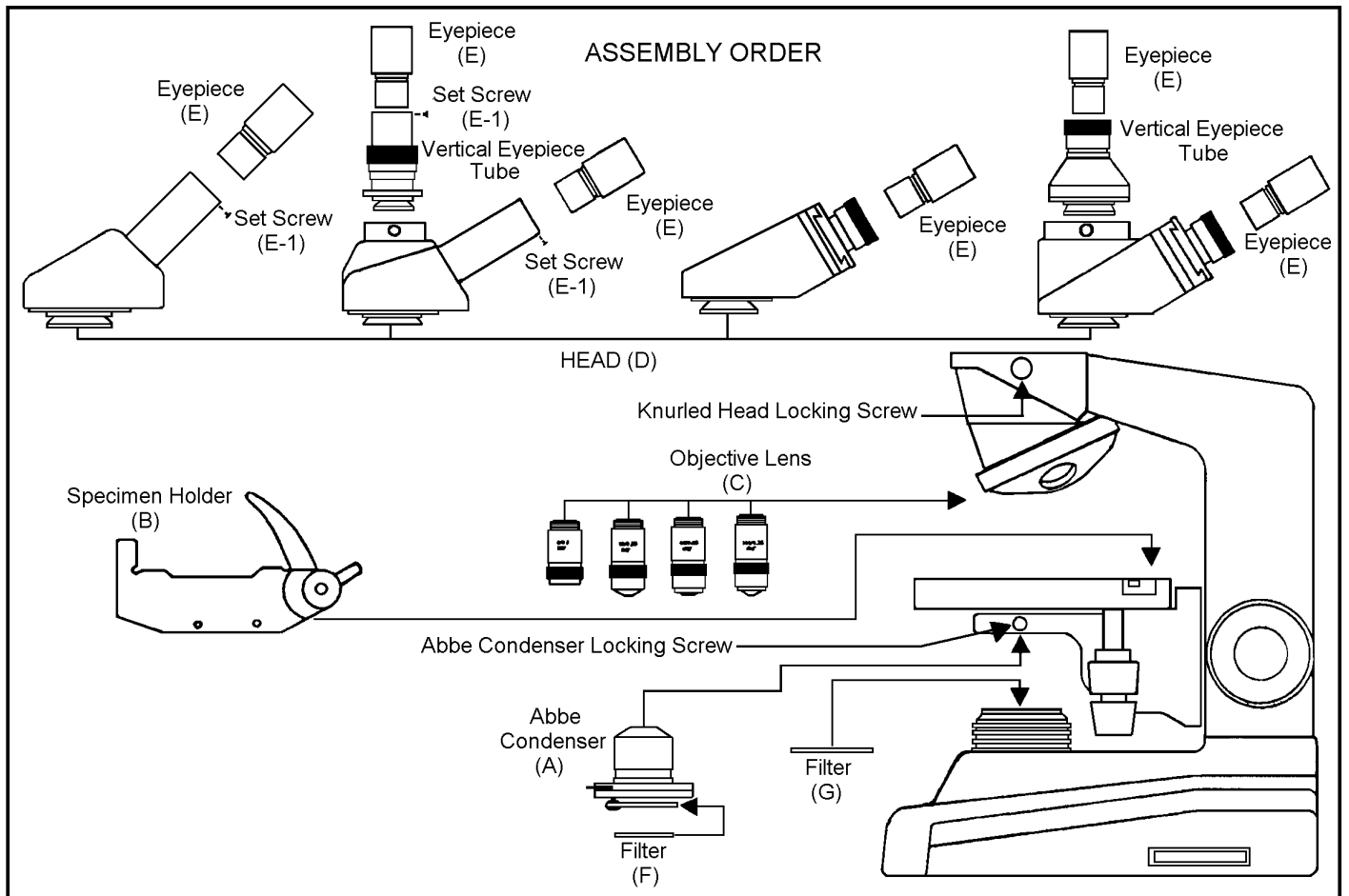
To protect focus mechanism during shipment, two black plastic wedges (b) and one black plastic block (c) are inserted at strategic points as indicated. These plastic parts **MUST** be removed prior to operating microscope. Failure to do so will result in damage to focusing mechanism and will void your warranty.

1. Remove two black velcro straps (a).
2. Remove wedge (b) by pulling apart the two parts of wedge in opposite directions.
3. Lower stage by rotating coarse focus knob, on side of microscope illustrated, in counter-clockwise direction



4. Remove block (c) from stand.
 5. These components should be retained with styrofoam container
- B. Carefully remove from the stand all tape and packing material used to protect microscope components during shipment. Remove black objective plugs from nosepiece.
 - C. Lay styrofoam container (B) flat and carefully remove head, eyepieces, rubber eyeshields, vertical eyepiece tube (model 161 only), four objectives, condenser, specimen holder, filters, fuse and dust cover. For Model 163 trinocular only, lay white box (C) flat and carefully remove vertical viewing eyepiece tube.
 - D. Unwrap components, making certain that lens surfaces do not come in contact with dust, dirt, fingerprints. Damage to optical surfaces can result from such contaminants, and reduce image quality.

II. ASSEMBLY



- A. Condenser: Rotate focusing knob to move stage platform to its highest position. Loosen the Abbe condenser locking screw and insert Abbe condenser into the mounting ring. Tighten locking screw.
- B. Specimen holder: Rotate coarse focusing knob to move stage platform to its lowest position. Remove two knurled screws from mechanical stage platform. Place specimen holder on stage and, using the two knurled locking screws, attach holder to mechanical stage.
- C. Objectives: With stage platform located at its lowest position. Remove the black objective plugs from the nosepiece, screw all the objectives into the nosepiece, making certain to mount them in consecutive order 4x, 10x, 40x, 100x.

- D. Heads: Mounting the head to stand. Loosen knurled head locking screw. Insert viewing head into stand by inserting head flange into receiving flange on arm of microscope. Lower the head until fully seated on top of arm. Position head so that it faces either forward or backward, whichever suits your preference or needs, and tighten knurled head locking screw.
1. Dual viewing teaching head - Mounting vertical eyepiece tube with diopter to head: Loosen knurled locking screw, remove black dust cap from vertical port. Insert vertical eyepiece tube with diopter into vertical port. Retighten knurled screw to secure vertical eyepiece tube in place.
 2. Trinocular head - Mounting vertical eyepiece tube with diopter to head: Loosen knurled locking screw, remove black dust cap from vertical port. Insert vertical eyepiece with diopter into vertical port. Retighten knurled screw to secure vertical eyepiece tube in place.
 - a. Trinocular head provided with a three position sliding rod to direct light through microscope. The three position sliding rod (b) allows user to easily direct microscope image into desired path.
 - 1) Rod pushed completely into head; 100% of microscope image is directed to binocular eyepieces.
 - 2) Rod at mid-position (pull or push rod until you feel a gentle click stop), 100% of microscope image is directed to trinocular port.
 - 3) Rod pulled to fully extended position; 30% of image directed to binocular eyepieces, 70% directed to trinocular port.
- E. Eyepieces: Remove the dust caps from eyepiece tubes. Avoid touching any lens surface.
- Model 160: Using a small jewelers cross head screwdriver, loosen the eyepiece locking screw E-1. Insert eyepiece into the eyepiece tube. Tighten the eyepiece locking screw.
- Model 161: Using a small jewelers cross head screwdriver, loosen the eyepiece locking screw E-1 on inclined eyepiece tube and vertical eyepiece tube. Insert eyepieces into eyepiece tubes. Tighten the eyepiece locking screws.
- Models 162 and 163: Insert eyepieces into the eyepiece tubes.
- F. Filter: Swing out filter holder and insert 32mm diameter blue filter.
- G. Filter: Insert 45mm neutral filter into the recess located at top of illuminator condenser.

III. OPERATION

- A. Illumination.
1. Before operating microscope, **adjust intensity control located on side of base to the minimum position.** This should be done prior to each time light is turned on or off. This will extend bulb life.
 2. **Make certain that the main voltage of your microscope corresponds to the voltage of your power outlet, either 120v or 220v. Insert microscope plug into matching voltage outlet.**
 3. Push rocker switch at rear of base to ON position.
 4. Rotate intensity dial on illuminator base until image is illuminated.
 5. Adjust intensity of light to match requirements of objective and specimen slide.
 6. In case of equipment malfunction, see "Trouble Shooting" procedures.
- B. Interpupillary adjustment of viewing head (Models 162 and 163 only)
1. Look through microscope and adjust distance between the two eyepiece tubes by grasping the sliding mounts to left and right of eyepieces and sliding together or apart.

2. When a full field of view is observed through both tubes, and images blend into one, interpupillary distance is corrected for your eyes. Check the interpupillary scale and note index reading for future reference, in case other users will be changing this adjustment from time to time.
3. Adjust the diopter scales, located on each eyepiece tube, to the same numerical value as indicated on the interpupillary scale. This must be done in order to maintain parfocality of objective lenses. If interpupillary distance is changed, adjust eyepiece diopters accordingly.

C. Focusing the microscope.

1. Position the 4x objective lens into the optical path, making sure that lens is properly indexed in its click-stop position.
2. Place standard specimen slide (cover slip up) on top of stage surface.
 - a. Swing moveable finger on slide holder outward. Place specimen slide against fixed side of slide holder. Slowly release moveable finger until it makes contact with specimen slide.
3. Rotate coarse focusing controls until specimen comes into focus.
4. Adjust fine focus controls until specimen is in sharp focus.
5. Adjust diopter for difference in eyesight.
 - a. Using right eye, peer into the right eyepiece tube. Adjust sharpness of image by utilizing fine focus controls.
 - b. Using left eye, peer into the left eyepiece tube. Adjust sharpness of image by turning diopter adjustment located on left eyepiece tube.
6. Adjusting the aperture (opening) of iris diaphragm.

Iris diaphragm should not be used to control the brightness of illumination. Iris diaphragms are designed to help achieve high resolution of specimen and provide contrast in the image. Smaller apertures will deliver higher contrast to image. However, closing aperture too much will reduce resolution. Experimentation is the best method of determining the correct opening of diaphragm. Some suggested openings for iris diaphragm are:

OBJECTIVE	DIAPHRAGM OPENING
4x	From fully closed to 1/8 open
10x	1/8 to 1/4 open
40x	1/4 to 1/2 open
100x	1/2 to 3/4 open

7. Changing magnification.
 - a. Rotate revolving nosepiece to position 10x objective into optical path.
 - b. This microscope has been parfocalized, which allows changes from one objective to another while requiring only a slight adjustment of the fine focus controls.
 - c. When changing to the 40x and 100x objective lens, care must be exercised in order to prevent damaging the front lens element and specimen slide.
 - d. In order to obtain maximum resolution of the 100x oil immersion lens, it is necessary to apply immersion oil between the coverglass of slide and front lens of the objective.
 - 1) Use of a very small amount of immersion oil is required.

- 2) All air bubbles must be removed from between lens and slide by rotating nosepiece back and forth.

Objective Specification Chart

Objective	N.A.	Color Code Ring	Field of View	Magnification
Din 4X	0.10	Red	4.5mm	40X
Din 10X	0.25	Yellow	1.8mm	100X
Din 40X	0.65	Blue	0.45mm	400X
Din 100X	1.25	White	0.18mm	1000X

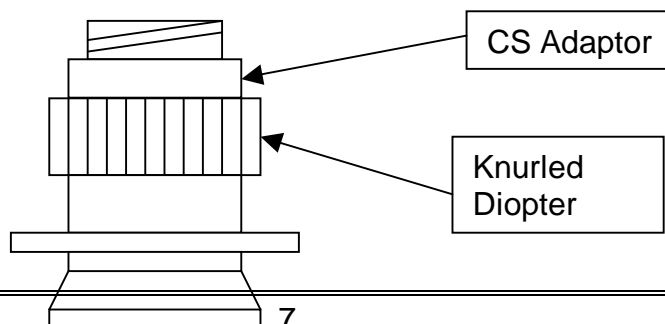
8. When finished viewing, all parts that come in contact with oil must be cleaned. Failure to do so could permanently damage the 100x oil immersion objective lens. Use of xylene or Windex to clean immersion oil off lens surfaces is recommended.
9. Coarse focus tension adjustment.
 - a. Tension adjustment knob is located between stand and coarse focus knob of microscope, on the right side.
 - b. To tighten tension of coarse focus knobs, turn control in a counter-clockwise direction. It is advisable to leave controls as loose as possible, tightening only enough to keep stage from drifting down and out of focus. To loosen tension, turn control in clockwise direction.

IV. ADAPTING CCTV VIDEO CAMERA (to dual head model only)

- A. To mount CCTV camera to dual head model #161, optional accessory #930-161V video adaptor is required. The adaptor has a 0.5x lens that assures image parfocality when viewed through a video monitor.

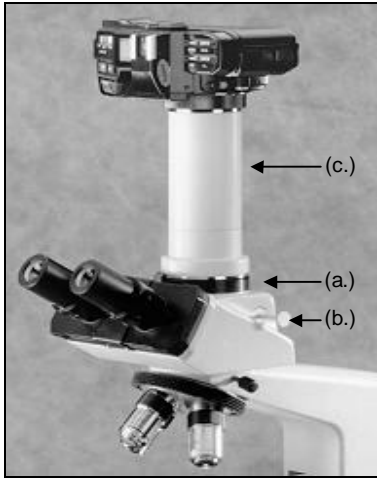
Your video adaptor can be utilized as a type "C" or "CS" adaptor. If your CCTV camera has a 1/2 inch chip, leave "CS" adaptor screwed onto the "C" adaptor. If your CCTV camera has a 1/3-inch chip, remove the "CS" adaptor by grasping the knurled diopter and turning the top "CS" adaptor counter-clockwise to remove. The remaining adaptor is a "C" type adaptor.

1. Remove front lens from CCTV camera. Thread front of camera onto threads of video adaptor.
2. Locate knurled screw located on side of dual viewing head. Turn knurled screw counter-clockwise to permit removal of black plastic disk covering the vertical port.
3. Insert video adaptor tube into vertical viewing port. If adaptor does not insert easily, further loosen knurled screw at side of port until adaptor tube drops into port and is firmly seated. Retighten knurled screw to secure adaptor and camera in place.
4. Proceed with operation of video camera and TV monitor according to manufacturers directions.
5. Place specimen to be viewed on stage and focus microscope as described in instruction manual.
6. With camera and monitor on, slowly rotate the knurled diopter on "C" adaptor until image is in focus on monitor. If microscope image, as viewed on TV monitor does not remain in focus when microscope magnification is changed, recheck CCTV camera chip size. Perhaps it will be necessary to either replace or remove the top "CS" adaptor ring in order for the video adaptor to be compatible with the chip size of your CCTV camera.



V. ADAPTING CCTV VIDEO CAMERA OR SLR CAMERA (to trinocular model only)

- A. Trinocular model #163 is equipped with a port (a.) on top of head. By using optional accessory adaptors, either CCTV video or 35mm cameras can be mounted onto the microscope.



The three position sliding rod (b.) allows use to easily direct microscope image into desired path.

- 1) Rod pushed completely into head; 100% of microscope image is directed to binocular eyepieces.
- 2) Rod at mid-position (pull or push rod until you feel a gentle click stop); 100% of microscope images is directed to trinocular port.
- 3) Rod pulled to fully extended position; 30% of image is directed to binocular eyepieces, 70% directed to trinocular port.

- B. To mount SLR camera, an optional accessory SLR adaptor (c.) is required.

Listed below is the optional accessory SLR adaptor, which includes a 2.5x photo lens which needs to be inserted into the SLR adaptor. Also listed are National part numbers for four commonly used T-mounts, available through your National dealer. A wide range of T-mounts, including these four, are also available from any camera store.

#903-163	SLR adaptor with 2.5x photo lens (fits Model 163 only)
#930-501	Canon T-mount
#930-502	Nikon T-mount
#930-503	Olympus T-mount
#930-504	Canon EOS T-mount

Remove front lens of SLR camera. Attach appropriate T-mount in place of front camera lens. Screw threaded end of T-mount onto threaded end of SLR adaptor.

Locate knurled screw located on side of trinocular port on microscope. Turn screw counter-clockwise to permit removal of black plastic disk covering trinocular port.

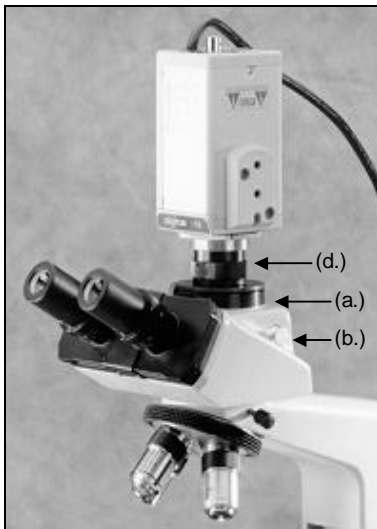
Insert SLR adaptor tube, with camera already mounted to adaptor, into vertical port. If adaptor does not insert easily, further loosen knurled screw at side of port until adaptor tube drops into port and is firmly seated. Retighten knurled screw to secure adaptor and camera in place. Pull sliding rod (b.) until half way extended, to direct 100% of microscope image to trinocular port.

Proceed with operation of camera according to manufacturers directions.

- C. To mount CCTV camera, optional accessory #930-005 video adaptor (d.) is required. This adaptor has an 0.5x lens which assures image parfocality when viewed through a video monitor.

Observe that video adaptor has two black knurled rings. If your CCTV camera has a 1/2 inch chip, leave both knurled rings in place, thereby creating a "CS" type mount. If your CCTV camera has a 1/3 inch chip, remove only the top black knurled ring from c-mount by turning counter-clockwise. The remaining black knurled ring is a "C" type adaptor.

Remove front lens from CCTV camera. Thread front of camera onto threads of video adaptor (d.).



Locate knurled screw located on side of trinocular port (a.) on microscope. Turn screw counter-clockwise to permit removal of black plastic disk covering trinocular port.

Insert video adaptor tube into trinocular port. If adaptor does not insert easily, further loosen knurled screw at side of port until adaptor tube drops into port and is firmly seated. Retighten knurled screw to secure adaptor and camera in place. Pull sliding rod (b.) until half way extended, to direct 100% microscope image to trinocular port.

Proceed with operation of video camera and TV monitor according to manufacturers directions. If microscope image, as viewed through TV monitor does not remain in focus when microscope magnification is changed, recheck CCTV camera chip size. Perhaps it will be necessary to either replace or remove the top black knurled ring in order for the video adaptor to be compatible with the chip size of your CCTV camera.

VI. MAINTENANCE

WARNING: FOR YOUR SAFETY, TURN SWITCH OFF AND REMOVE PLUG FROM POWER SOURCE OUTLET BEFORE MAINTAINING YOUR MICROSCOPE. TO AVOID SHOCK OR FIRE HAZARD, IF POWER CORD IS WORN, CUT OR DAMAGED IN ANY WAY, HAVE IT REPLACED AT ONCE.

A. OPTICAL MAINTENANCE

1. Do not attempt to disassemble any lens component. Consult an expert technical service company when repairs not covered by these instructions are required.
2. Prior to cleaning any lens surface, brush dust or dirt off lens surfaces using a camel hair brush. Or use air to blow dust and lint off surfaces. Use of compressed air in a can, available at any computer supply store, is a good source of clean air.
3. Cleaning eyepiece lenses.

Do not remove eyepiece from eyepiece tube. Clean only the outer surface. Breath on lens to dampen surface, then wipe with lens paper. Do not wipe lens surface while dry as lenses are scratched very easily. Wipe a circular motion from center to outer edges.

4. Cleaning objective lenses.

Do not remove objective lenses from microscope. Clean front lens element only. Using a cotton swab saturated with distilled water, clean front lens surface. Inspect the lens using a magnifying glass to insure that the element is clean. If immersion oil or specimen material of any kind is evident, use a cotton swab dipped in a small amount of xylene or Windex to clean all foreign material from objective lens surface. Such material will reduce, or totally block, image quality.

5. Cleaning condenser lens.

Clean only the top lens surface, visible when looking through hole in top of stage. Use same procedure as used for eyepiece or objective lenses.

6. Illuminator condenser lens.

Use same procedure as used for eyepiece or objective lenses.

B. ELECTRICAL MAINTENANCE

WARNING: FOR YOUR SAFETY, TURN SWITCH OFF AND REMOVE PLUG FROM POWER SOURCE OUTLET BEFORE MAINTAINING YOUR MICROSCOPE.

1. Replacement of lamp.

- a. Carefully lay instrument on its side, taking care to avoid damage to the specimen slide holder located on top of mechanical stage.
- b. Loosen large chrome locking screw located on hinged door of illuminator base.
- c. Swing door open to expose the halogen lamp.
- d. Using a tissue or cloth to gently grasp the halogen bulb, pull straight out of lamp socket.
- e. Your microscope requires a 12 volt, 20 watt halogen bulb, available from the dealer from which you purchased your microscope. This is a common microscope bulb, Osram #64425.
- f. Make certain that new bulb is clean, as fingerprints on bulb can affect light transmission. Grasping bulb gently with a tissue or cloth, insert pins straight into lamp socket.
- g. Carefully clean lamp to assure that it is clean and free of all fingerprints.
- h. Close hinged door and tighten locking screw.

2. Replacement of fuse (National #801-160).

The fuse is located at right rear side of microscope base. To remove fuse from holder, insert a 6mm screwdriver blade into slot located in rear of fuse cap. Slightly depress and rotate screwdriver $\frac{1}{4}$ turn in direction of arrow, release pressure on screwdriver to release the fuse cap. Pull cap and fuse out of fuse holder. Insert proper 0.5 amp time delay fuse into fuse cap. Insert fuse cap into fuse holder. Using screwdriver rotate fuse cap assembly in opposite direction of arrow until guide slot engages, depress fuse cap and rotate $\frac{1}{4}$ turn to lock into fuse holder.

VII. TROUBLESHOOTING

ELECTRICAL

PROBLEM	REASON FOR PROBLEM	SOLUTION
Light fails to operate	Outlet inoperative. AC power cord not connected. Lamp burned out. Fuse burned out. Fuse burns out too soon. Fuse blows instantly when replaced. Incorrect lamp used improper voltage or base.	Have qualified service technician repair outlet Plug into outlet. Replace lamp. Replace fuse. Replace with proper fuse (Time delay). Unit has short, have qualified technician repair electrical short. Replace with specified lamp.
Light burns out too soon	The voltage is too high.	Adjust intensity control to the minimum position before turning the power switch on.
Light bulb burns out immediately	Incorrect lamp used.	Use proper lamp (voltage). Plug unit into proper outlet 120v or 220v
Light flickers	Lamp not properly inserted into socket. Lamp about to burn out. Fuse holder not locked into proper position. Loose connection at AC outlet.	Properly insert lamp. Replace lamp. Properly install fuse holder. Have qualified service technician repair outlet.

IMAGE QUALITY

PROBLEM	REASON FOR PROBLEM	SOLUTION
No image.	Nosepiece not indexed properly. Light too bright	Move revolving nosepiece until objective lens clicks into position. Adjust light intensity control to a lower position.
Poor resolution. (Image not sharp)	Objective lens dirty. Eyepiece lens dirty. Slide upside down. Cover slip on specimen slides too thick. Too much light. Condenser lens dirty. Rack stop not set a proper position.	Clean objective lens. Clean eyepiece lens. Turn specimen slide over (cover slip facing up). Use 0.17mm thick cover slip. Adjust light intensity control to a lower position. Iris diaphragm not properly adjusted. Clean condenser lens. Adjust rack stop.
Spots in field of view.	Eyepiece dirty. Specimen slide dirty. Condenser lens dirty.	Clean eyepiece lenses. Clean slide. Clean lens of condenser.
Uneven illumination of field.	Nosepiece not properly indexed. Diaphragm not properly indexed.	Revolve nosepiece into positive index stop. Adjust iris diaphragm to proper level.

MECHANICAL PROBLEM

PROBLEM	REASON FOR PROBLEM	SOLUTION
Does not stay in focus.	Stage drops down	Adjust tension adjustment knob.

OPTIONAL ACCESSORIES AND PARTS:

#610-160	WF10X Eyepiece
#610-160R	WF10X eyepiece w/reticle, 10mm/100div.
#704-160	DIN 4X objective lens, 0.10 N.A.
#710-160	DIN 10X objective lens, 0.25 N.A.
#740-160	DIN 40X objective lens, 0.65 N.A.
#799-160	DIN 100X objective lens, 1.25 N.A.
#704-160ASC	DIN 4X Super High Contrast objective lens, 0.10 N.A.
#710-160ASC	DIN 10X Super High Contrast objective lens, 0.25 N.A.
#740-160ASC	DIN 40X Super High Contrast objective lens, 0.65 N.A.
#799-160ASC	DIN 100X Super High Contrast objective lens, 1.25 N.A.
#704-160SP	DIN 4X Semi-plan objective lens, 0.10 N.A.
#710-160SP	DIN 10X Semi-plan objective lens, 0.25 N.A.
#740-160SP	DIN 40X Semi-plan objective lens, 0.65 N.A.
#799-160SP	DIN 100XR Semi-plan objective lens, 1.25 N.A.
#704-160P	DIN 4X Plan objective lens, 0.10 N.A.
#710-160P	DIN 10X Plan objective lens, 0.25 N.A.
#740-160P	DIN 40X Plan objective lens, 0.65 N.A.
#799-160P	DIN 100X Plan objective lens, 1.25 N.A.
#800-160	Replacement bulb, 12v 20 watt halogen bi-pin
#801-160	Replacement fuse, 0.5 amp time delay (5mm dia. x 20 mm long)
#926	Phase contrast set: Centering telescope, PLAN/Phase 10x, 20x, 40x, 100xR (oil immersion) objectives, Phase turret condenser assembly including one brightfield position, blue & green filters, storage case
#930-005	Video C-mount adaptor w/0.5x lens (for use with trinocular model only)
#930-161V	Video C-mount adaptor w/0.5x lens (for use with dual head model only)
#930-163	SLR photo adaptor w/2.5x photo lens (for use with trinocular model only) (T-mount not included)
#930-501	T-mount for Canon FD SLR camera
#930-502	T-mount for Nikon SLR camera
#930-503	T-mount for Olympus SLR camera
#930-504	T-mount for Canon EOS SLR camera
#965-160	Eyepiece reticle, 10mm/100 div.
#975-002	Carrying case, anodized aluminum, fabric lining, accessory pockets, Velcro straps, keyed lock

WARRANTY - 5 YEAR LIMITED WARRANTY

Manufacturer warrants this instrument to be free from defects in material and workmanship under normal use and service for 5 years from date of purchase. It does not cover damage resulting from abuse or misuse, repairs or alterations performed by other than authorized repair technicians or damage occurring in transit. Warranty does not cover bulbs or fuses.

For warranty service, instrument should be well packed to avoid damage in transit, including a description of the difficulty, and shipped postage prepaid to National at the address on front. National will repair or replace at no charge and return postage prepaid. If failure was caused by misuse, alterations, accident, or abnormal conditions of operation, an estimate for repairs will be submitted for your approval prior to work being performed.

If you have questions concerning this product or warranty, contact dealer from which it was purchased. Or contact National, asking for warranty assistance.

