REFERENCE MANUAL

AO Series Sixty Student Microscope

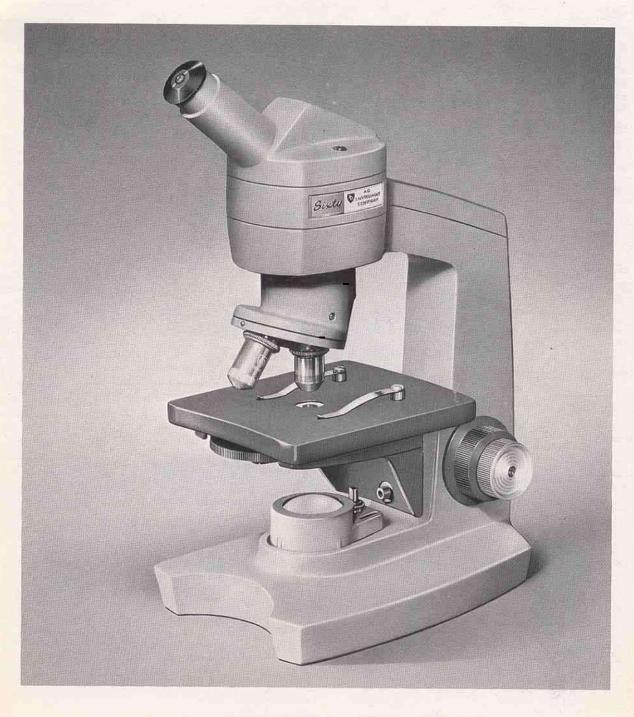
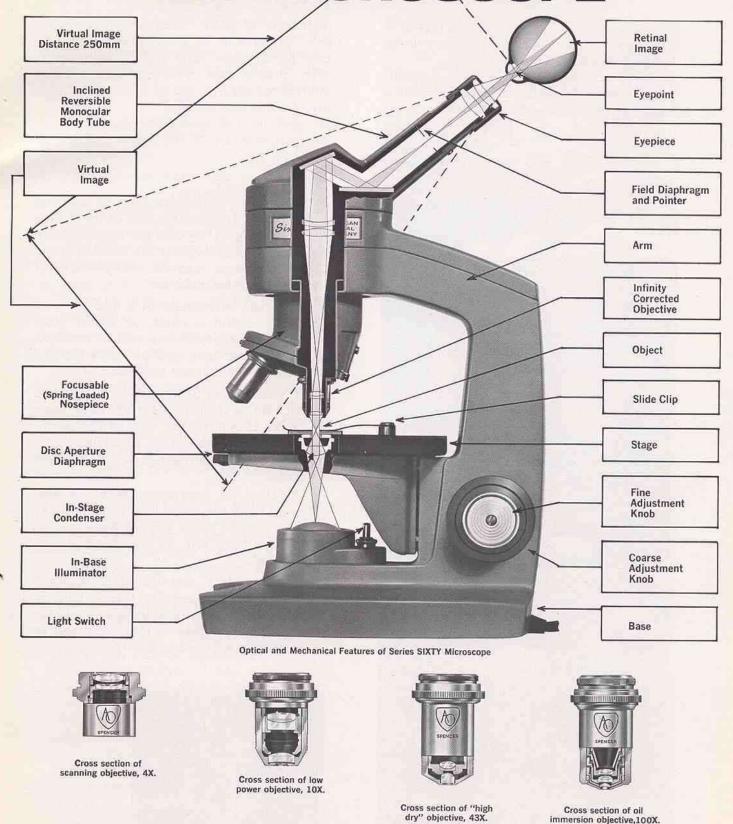




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Optical and Mechanical Features of





AMERICAN OPTICAL CORPORATION SCIENTIFIC INSTRUMENT DIVISION . BUFFALO, N. Y. 14215

immersion objective,100X.

INTRODUCTION

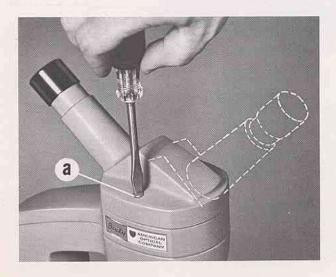
You now possess one of the finest and most precise scientific instruments available on the market today.

You are assured of time proven dependability. Since original Series Sixty models were introduced in 1961, the many, many

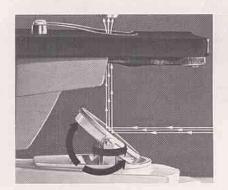
thousands in daily classroom use provide proof positive of its virtually maintenancefree performance and optical superiority. With proper care, your AO Series Sixty Microscope assures you of years of satisfying, trouble-free service.

PRELIMINARY PROCEDURE





- Remove the microscope from its shipping carton by grasping the arm of the instrument; support beneath the base with the other hand. Whenever the position of the microscope is changed, always carry in the illustrated manner.
- Place the microscope on a firm table or bench. Select a chair, or adjust stool height, so that the user will be comfortable in near-erect posture when viewing through the inclined eyepiece.
- If your Series Sixty model is equipped with an *In-Base illuminator*, most users prefer to reverse the body of the microscope for easier access to slides, objectives, disc diaphragm or iris diaphragm lever.
 - Position the instrument with the arm away from the user; remove screws (a) with correct sized screwdriver; reverse inclined body 180° as illustrated and reassemble.
- 4. If your Sixty microscope is equipped with a mirror assembly, direct the light beam from a suitable illuminator onto the mirror and adjust so that light will be uniformly reflected into the condenser.



EFFECTIVE USE OF THE SERIES SIXTY MICROSCOPE

The following step-by-step operating procedure should be followed carefully when first using an AO Sixty microscope. Because the instrument is designed specifically for fast, simplified use, correct operating technique soon becomes automatic.

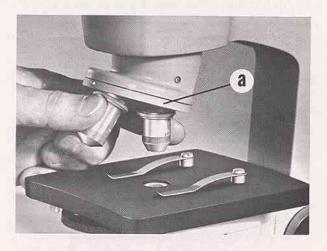
- Rotate the nosepiece (a) so that the "green" coded, 10X objective is in operating position.
- 2. Turn the disc diaphragm (a) to the III setting or open iris diaphragm (b) approximately half way.
- For greater access to the stage and slide clips, raise the nosepiece using a coarse adjustment knob.
- Turn on In-Base illuminator. If using a separate illuminator, adjust mirror tilt as required.
- 5. Insert a good stained specimen slide of standard thickness (approx. 1.25mm) beneath the stage slide clips (a) and with the naked eye position the specimen directly above the center of the condenser. With In-Stage condenser, take advantage of the unique white opaque background annulus (b) to help you more easily find and position the specimen over the condenser.

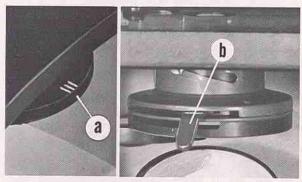
Note: As a part of good technique, place the slide on the stage beneath the raised part of the slide clips then pull the slide forward to receive the tension near the ends of the clips.

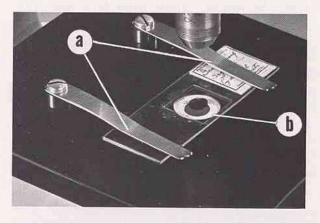
6. Rotate coarse adjustment knob (a) in the direction illustrated until a positive stop is reached. View through the eyepiece and, without disturbing the coarse adjustment setting, slowly rotate a fine adjustment knob (b) in appropriate direction until specimen detail is in sharp focus.

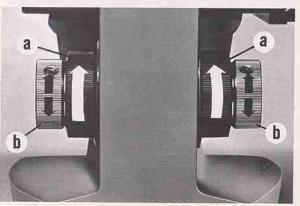
Note: Again as a part of good technique, keep both eyes open and use alternately while viewing through the instrument to eliminate eye strain.

7. If there is too much light, such that the specimen cannot be seen clearly against the glare, rotate the disc diaphragm to a smaller opening. If using a condenser









with an iris diaphragm, close down the diaphragm. The use of a blue filter (built into AO 614 In-Base Illuminator) will enhance contrast.

When using a mirror, if the field of view is not uniformly illuminated, refine the mirror tilt and/or position of external illuminator so that the specimen field is evenly illuminated.

8. Once specimen detail is in sharp focus under the 10X objective, it is now possible to rotate the revolving nosepiece to other objectives without changing the position of the coarse adjustment knob. Very little refocusing with the fine adjustment is required since AO Series Sixty Microscope objectives are parfocal. It is important to remember that each time a different objective is used, the disc or iris diaphragm setting must be changed.

CORRECT DIAPHRAGM SETTINGS

Use disc diaphragm setting I or II with "yellow" coded, 43X objective and settings III or IIII with "green" coded, 10X objective for stained slides of good contrast. With experience, correct setting of the iris diaphragm can be made from the appearance of the specimen image. Many users fully open the iris diaphragm and then close down until desired specimen contrast is achieved without loss of detail or resolution.

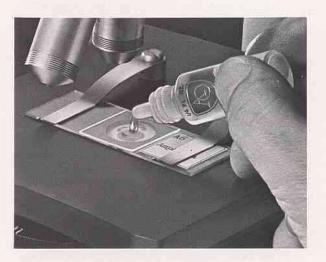
Since numerical apertures of objectives vary directly with the initial magnifications of objectives, it is necessary to change the substage diaphragm setting whenever the nosepiece is rotated to another objective. The greater the initial magnification of the objective... the larger its numerical aperture... consequently, the wider the cone of light you'll have to present to the specimen and objective by properly opening the substage diaphragm.

Unstained and living specimens, because of their low contrast characteristics, can usually be viewed more effectively by setting the diaphragm at or near minimum opening. Reducing the diaphragm setting increases definition, contrast and depth of focus at the sacrifice of resolution. Do not, however, close it to such an extent as to introduce undesirable diffraction or distortion of specimen detail . . . select the best compromise by trial and error.

OPERATING PROCEDURE FOR USE OF 100X OIL IMMERSION OBJECTIVE

Use of the 100X oil immersion objective is best accomplished . . . without danger of damaging specimen slide and objective . . . by utilizing the full value of the protective Autofocus stop feature. Proceed in the following manner:

- 1. Focus onto the specimen progressively with the 10X and 43X objective following steps in "Effective Use of the Series Sixty Microscope".
- 2. Fully raise the nosepiece by means of a coarse adjustment knob without disturbing the position of the fine adjustment knob.
- Place a small drop of non-drying Crown or Cargille's immersion oil (mineral oil or other substitutes should not be used) in the center of the circle of light formed on the specimen slide.



Turn the nosepiece to the "red" coded, 100X objective.

Grasp a coarse adjustment knob and rotate it to its original stop position.

Bring the specimen into sharp focus with fine adjustment knob.

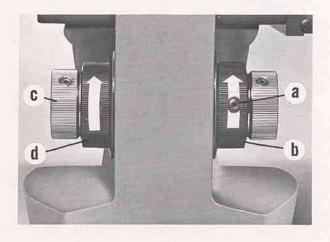
Note: In following the above procedure, remember the advisability and necessity of opening the condenser iris diaphragm.

HOW TO RESET AO AUTOFOCUS STOP

Autofocus, originally developed by American Optical, is a quick focus-finder built into the coarse adjustment assembly. An outstanding convenience feature, Autofocus eliminates lost time in "searching" for correct focus with the coarse adjustment. Together with the spring loaded nosepiece, it eliminates slide breakage and objective damage.

Autofocus stop is variable to accommodate thick chambers such as hemacytometers but does not require adjustment for slides which vary in thickness as much as \pm 0.5mm from normal 1.25mm slide thickness. To vary or reset the Autofocus for thicker slides or chambers, or to reset at original position, follow these steps:

1. Use 10X objective.



- Loosen Allen screw (a) of coarse adjustment knob (b) with "L" shaped 3/32"
 Allen wrench . . . do not under any circumstances disturb other Allen screws.
 An instructor should be present to make certain that latter rule is not violated.
- Set fine adjustment (c) at mid-excursion by positioning the fine adjustment at three revolutions from the bottom stop of its range.
- Insert the specimen slide beneath the stage slide clips . . . orient directly above center of condenser.

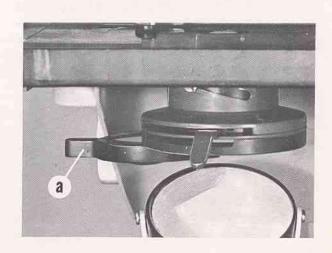
- Bring specimen detail in sharp focus by carefully rotating coarse adjustment knob
 (d) without changing setting of fine adjustment knob (c) established in step 3.
- Now, rotate coarse adjustment knob (b) in the direction illustrated until you reach a positive stop . . . hold the knob in this position . . . and tighten Allen screw (a) securely.

SPIRAL CONDENSER PRE-SET FOR OPTIMUM PERFORMANCE

If your Series Sixty microscope is equipped with a spiral focusing condenser mount, it has been pre-set at the factory in optimum operating position. Modern AO microscopes with built-in illuminators eliminate the necessity for refocusing the substage condenser for all routine Bright-Field illumination through the complete range of magnifications. Provision is made, however, for adjustment of condenser height for any unusual requirements.

AUXILIARY SWING-IN CONDENSER

Models X62 microscopes are equipped with auxiliary swing-in condenser (a). The swing-in condenser is intended only for use with the low power, 4X objective to fully illuminate its larger field of view when using an external light source. Swing it out of the path of light when other objectives are used.



SIMPLE MEASUREMENTS WITH SERIES SIXTY

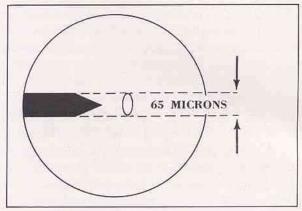
10X Wide Field eyepiece includes a pointer which also may be used to conveniently determine approximate lateral dimensions of a specimen or specimen detail at the object plane. When the eyepiece is used with a 4X, 10X, 43X, or 100X objective, the base portion of the pointer represents approximately 160, 65, 15, and 7 microns respectively. (1 micron

$$= .001 \text{ millimeter} = \frac{1}{25,400} \text{ inch})$$

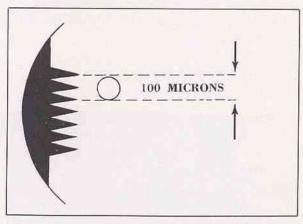
EXAMPLE: Specimen viewed under 10X eyepiece and 10X objective has a length of approximately 65 microns.

10X Huygenian eyepiece includes a pointer with a measuring scale. The "saw tooth" scale has six equal divisions between teeth. When used with 4X, 10X, 43X, or 100X objectives, the distance between the points of any two teeth represents approximately 120, 50, 12, and 5 microns respectively.

EXAMPLE: Spherical specimen viewed under 10X eyepiece and 10X objective has a diameter of approximately 100 microns.



10X EYEPIECE WITH 10X OBJECTIVE



10X EYEPIECE WITH 10X OBJECTIVE

COMMON OPTICAL AND MECHANICAL MICROSCOPE TERMS

Aberration, Chromatic Present in a lens system when the rays of the component colors of white light are not simultaneously brought to one focus, thus producing undesired color fringes in an image.

Aberration, Spherical When light rays of one color passing through the outer periphery of a lens do not come to the same focus as the rays passing through near the center. The image is more or less blurred.

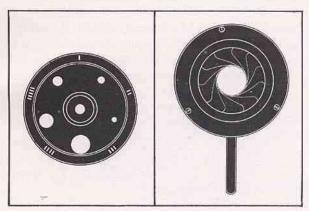
Achromatic Literally free of color aberration. Lenses and prisms within the microscope are corrected to transmit a faithful image of the specimen virtually free of color fringes.

Alignment Mutual coincidence of optical and mechanical components along a common axis.

Aperture Diaphragm A rotatable disc diaphragm or iris diaphragm* located beneath the microscope condenser*. It is used to skillfully control the angle of the solid cone of illumination presented to a specimen and entering the objective. Resolution*, or contrast, and definition* of the specimen significantly depend upon the proper setting of the aperture diaphragm. It is important to note that

*Term defined in alphabetical order.

the control of the intensity of illumination is not a function of the aperture diaphragm; absorption filters are used for this purpose.



DISC DIAPHRAGM

IRIS DIAPHRAGM

Autofocus Stop Autofocus, originally developed by AO, is a quick focus-finder which essentially eliminates objective*, slide, and specimen damage; is also a definite time saver. Autofocus is built into the coarse adjustment assembly; can be easily reset when desired.

Bright-Field Illumination The most common type of illumination applied in ordinary microscopy. Specimen image appears dark against a brighter background. Bright-Field is the opposite of Dark-Field* illumination.

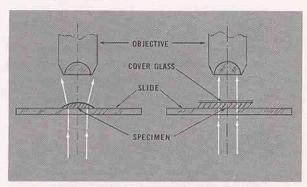
Coarse Adjustment The larger set of knobs which actuate the nosepiece assembly of AO microscopes. Used for rapid, or coarse, focusing onto specimen mounted on very thick or well-type slides. When standard thickness slides are used, the coarse adjustment is merely rotated to a distinct stop to take full advantage of "Autofocus".

Compound Microscope An exacting optical instrument used to magnify and resolve fine detail within a transparent specimen. It differs from the simple microscope (ordinary magnifier) in that it has two separate lens systems: an objective, located near the specimen, which magnifies the specimen in a definite amount; and an eyepiece* which further magnifies the image formed by the objective. The resultant magnification* observed

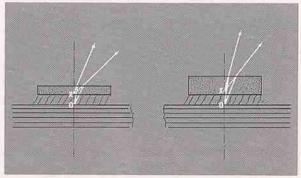
by the eye is equal to the product of the primary magnification of both lens systems.

Condenser The lens or lens system to collect illumination light rays and converge them to a focus. Located directly beneath the microscope stage. Coupled with the aperture diaphragm, the condenser constitutes one of the most important and necessary features of a good microscope. For this reason, AO microscopes are equipped with condensers and diaphragms to controllably increase resolution, enhance contrast, reduce glare* and assure optimum results with all objective-eyepiece combinations.

Cover Glasses Square, rectangular or circular coverslips of thin, optically flat glass used to cover microscope slide specimens. The thickness of the cover glass affects the light rays and most microscope manufacturers design objectives for use with cover glasses having a thickness of 0.18mm. It is particularly recommended that cover glasses with thickness of 0.18±.02mm be applied to all specimen slides which will be observed critically through a 43X or 45X objective.



THE EFFECT OF A COVER GLASS



THE EFFECT OF COVER GLASS THICKNESS

Dark-Field Illumination A method of illuminating the specimen without admitting light directly into the objective. Specimen image appears bright against a dark background. Achieved by the insertion of a dark-field stop into the condenser mount of the microscope or the substitution of a dark-field condenser in lieu of a standard condenser.

Definition The faithfulness with which the optical system magnifies and reproduces the specimen detail. The brilliance, clarity, distinctness and sharpness of the microscope image.

Depth of Focus The thickness of the specimen which may be seen in focus at one time.

The greater the magnification, the greater the numerical aperture* and the shorter the focal length . . . the thinner is the layer in focus at one time. The lesser the magnification, the lesser the numerical aperture and the longer the focal length . . . the thicker is the layer in focus at one time.

The longer focal length lenses of lesser magnification are usually more satisfactory for the study of the general arrangement of the specimen because of the greater depth of focus...the field of view* is larger and the image brighter.

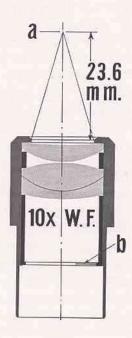
Dry Objective Microscope objectives designed to be used dry; that is, without immersion oil. The 43X or 45X objective is quite frequently referred to as the "high dry" objective; the 10X, "low dry" objective.

Empty Magnification Large magnification which increases size without enhancing resolution of the specimen detail. Although eye sensitivity varies from one individual to another, the limit of effective magnification should be in the range of 500 to 1000 times the numerical aperture (N.A.) of the objective. For example, a 43X objective with a N.A. 0.55 has effective maximum magnification of $1000 \times 0.55 = 550X$; a 45X, N.A. 0.66 objective, 660X.

Equivalent Focal Length Generally used to designate the true focal length of a microscope objective.

Evepiece The topmost optical lens system of a microscope, sometimes referred to as "ocular", which is used by the observer to further magnify the primary image transmitted and amplified by the objective. With the eye positioned at the eyepoint* of the eyepiece, it forms a virtual image* at approximately 250mm from the eye. The two most common types of eyepieces are called Huygenian* and Wide Field. The latter, as the name implies, provides approximately a 25% larger field of view and subtends a higher eyepoint. Consequently, it is better suited for observing larger areas of a specimen and accommodating users wearing eyeglasses.

Eyepoint The point on the axis above the eyepiece where all the principal rays of light intersect (a). For best results, the eye should be positioned at or above this point which can be found by holding a ground glass or paper tissue at about 7.4mm above the eyelens (top lens) of the Huygenian eyepiece, or 23.6mm above the eyelens of the Wide Field eyepiece supplied with AO Series Sixty and Fifty Microscopes.



Field Diaphragm A diaphragm limiting the field of view. In an eyepiece supplied with Series Sixty or Fifty, the diaphragm is adjacent to the pointer (b).

*Term defined in alphabetical order.

Field of View The visible area seen through the microscope when a specimen is in focus. It is usually expressed in mm diameter and can be determined by focusing onto a finely graduated, transparent millimeter scale placed on the microscope stage. See Table at end of terms and note that the field of view varies directly with the resultant magnifications . . . the greater the magnification, the smaller the field of view.

Fine Adjustment Smaller set of focusing knobs controlling the precise, fine movement of the ball-bearing nosepiece assembly. The mechanical slip-clutch at each end of fine adjustment excursion prevents jamming and damage to the focusing mechanism.

Glare Unfavorable light scattered by a specimen spoiling image detail. Scattered or strayed light within a microscope system is generally caused by improper use of diaphragms and condensers.

Huygenian Eyepiece Relatively simple, yet suitable, type of eyepiece invented by Christian Huygens, Dutch astronomer and mathematician.

Illumination The full capabilities of a microscope are not obtained unless the illuminator is efficient. Daylight is not very satisfactory because of its variability and, consequently, artificial light is generally used. The In-Base illuminators designed for use with the AO Series Sixty and Fifty microscopes are ideally suited for good results. They are an integral part of the instruments; assure correct alignment at all times; fully illuminate the field of view and satisfy the numerical aperture requirements of all objectives.

Immersion Oil An oil having proper refractive index*, dispersion and viscosity characteristics for use between a 100X "oil immersion" objective and specimen cover glass. Crown or Cargille's nondrying oils should be used instead of cedarwood or other oils for this purpose.

Iris Diaphragm An assembly of thin metal leaves controllable by a lever to produce variable sized opening. It is generally associated with microscope condensers and illuminators of intermediate and advanced types.

Lens A convex or concave transparent glass component for changing the direction of rays of light and thus magnify or reduce the apparent size of objects.

Light The human eye can see only with radiation of 400 to 700 millimicrons and is most sensitive at 555 millimicrons, or .555 microns, yellow-green light. (1 micron is equal to one-thousandths of a millimeter.) Light is radiant energy of above wavelengths which upon reaching the retina of the eye stimulate nerve impulses to produce the sensation of vision. White light is composed of a mixture of colored light of different wavelengths. When specimens are too transparent to be seen effectively, they may be stained . . . then the specimen can be seen by the color image formed as the dye absorbs certain wavelengths of light and transmits the others to the eye.

Magnification The ratio of the apparent linear size of an object as seen through the microscope (the virtual image) to the size of the object as it appears to the unaided eye at a distance of ten inches. The ratio is usually expressed in terms of "diameters", "power", "X", or "times", for example, 100X.

The compound microscope has two separate lens systems. The one nearest the object (the objective) magnifies the specimen a definite initial amount. The others lens system, the eyepiece, further magnifies this image (real image*) so that the resultant image seen by the eye (virtual image) has a magnification approximately equal to the product of the two systems. The primary magnification of objectives and eyepieces are engraved on each such part.

To determine exact magnification of the combined systems, project the image of a stage micrometer onto a screen or ground glass located 250mm above the eyepoint and measure the magnification directly against an accurate millimeter scale.

Magnification alone is not the aim of the finest microscopes. See "Empty Mag-

nification". The amplified or enlarged image is not helpful unless more detail ... resolution ... becomes visible.

Numerical Aperture (N.A.) A designation, usually engraved on objectives and condensers, expressing mathematically the solid cone of light delivered to the specimen by the condenser and gathered by the objective. The higher the numerical aperture of an objective the greater the resolving power of the objective. To satisfy this condition, however, it is necessary that the N.A. of the condenser be equal to or greater than the N.A. of the objective. For example, a condenser with N.A. 0.55 is insufficient to derive the full resolving power of a 100X oil immersion objective rated at N.A. 1.25.

Objective The complex lens system located directly above the object or specimen. It is the most exacting sub-assembly of a microscope since it is called upon to faithfully magnify and resolve specimen detail.

The bottom-most lens of the objective produces the magnification and the balance of the lenses redirect the image forming rays to the optical axis at the back focal plane of the objective where the resultant image is still further relayed and magnified by the eyepiece. All objectives supplied with AO's Series Sixty and Fifty microscopes are parfocal*, parcentered*, and infinity corrected for superior optical and mechanical performance, and color coded for easy identification. See Table at end of terms re: working distance, resultant magnification and field of view.

Optics The science dealing with the properties of light and vision.

Optical Glass A very high quality glass made especially for use in scientific instruments. Good microscope lenses and prisms are made from such glass having specific refractive index* and dispersion values.

Optical Filters Colored or neutral, all glass or laminated gelatin filters used to modify the light source. The light from a tungsten filament bulb is yellow and is usually rendered whiter by inserting a blue filter to absorb the excess red. The selective use of complimentary filters can do much to enhance stained detail within specimens.

Parcentered A term applied to objectives indicating that when a specimen detail is in the center of the field of view of one objective, the detail will essentially remain in the center of the field when the next objective is rotated into position.

Parfocal A term applied to objectives and eyepieces when practically no change in focus has to be made when one power is substituted for another. The objectives on the revolving nosepiece of a microscope are parfocalized so that only a slight turn of the fine adjustment is required when changing from low to a higher power objective.

Real Image (Aerial Image) The image formed in space by a system of lenses. Its presence can be viewed only by the insertion of a receiving screen, ground glass plate or projection screen.

Refraction The bending of a ray of light with a change in speed when it enters a transparent medium of different density.

Refractive Index A relationship between the sine of the angle of incidence and the sine of the angle of refraction when a ray of light passes from air to a transparent medium.

Resolving Power (Resolution) The ability of a microscope to reveal fine detail. It is stated as the least distance between two lines or points at which they are seen as two, rather than as a single blurred object.

Resolving power is a function of the wavelength of light used and the greatest cone of light which can enter the objective. The numerical aperture is engraved on objectives and may be used to compute the limit of resolution by apply-

ing formula $R=\frac{\text{wavelength}}{2\,\text{N.A.}}$. For example, a 10X objective, used at full numerical aperture N.A. 0.25, with green light having a wavelength of 0.56 micron:

$$R = \frac{.56}{2 (0.25)} = 1.1$$
 micron.

*Term defined in alphabetical order.

Retinal Image The image formed at the retina of the eye.

Spectacles and Eyeglasses Spectacles and eyeglasses corrected only for near or farsightedness need not be worn when using a microscope. The person merely focuses the instrument with the fine adjustment differently from someone else. If, however, spectacles have a correction for astigmatism, it is desirable that they be worn because the microscope obviously cannot correct for such deficiency and severe eyestrain and poor vision may result.

Virtual Image The apparent size and position of the object specimen. This image (not a real image) seen with the microscope appears to be about as far away as a book is held when reading print of average size. This distance is generally agreed to be about 10 inches.

Working Distance The distance between the front mount of the objective and the top of the cover glass when the microscope is focused on a thin specimen preparation. The greater the primary or initial magnification of the objective, the smaller the working distance. (See Table below.)



Since all objectives are designed for use with cover glass thickness of 0.18mm, make it a practice to use this proper thickness cover glass over all preparations. It is significantly important to recognize that too thick a preparation may make it impossible to focus onto its deepest detail with the 100X, or possibly with a 43X or 45X objective, because of the relatively short working distance of high powered objectives.

TABLE OF RESULTANT MAGNIFICATIONS, FIELD OF VIEW AND WORKING DISTANCES

		OD IFOTIVE	•			EYEI	PIECES	
34	OBJECTIVES					ian 10X	Wide Fig	eld 10X
Catalog Number	Initial Magnification	Numerical Aperture	Equivalent Focal Length	Working Distance	Resultant Magnification	Field of View	Resultant Magnification	Field of View
103	4X	.10	40mm	17.5mm	40X	3.6mm	40X	4.6mm
113	10	.25	16	6.9	100	1.4	100	1.8
114	43	.55	4	.6	430	.36	430	.46
1079	100	1.25	1.8	.10	1000	.15	1000	.18

PROPER CARE OF SERIES SIXTY MICROSCOPE

The Series SIXTY Microscope is a precision instrument made from valuable materials by expert craftsmen and should be treated accordingly. If properly used and cared for, it will literally last a lifetime without appreciable wear or change in appearance and performance.

The following rules, cautions and maintenance hints should be observed:

1. Microscope Stand and Mechanical Parts

- a. Use both hands when carrying the instrument. One, firmly grasping the arm of the microscope; the other, beneath the base. Avoid sudden jars.
- b. The dove-gray finish is Epoxy . . . tough and durable . . . resists chipping, staining and corrosive action of common laboratory chemicals. Clean with very mild soap or detergent solution when required. Other metal surfaces may be similarly cleaned. Dampen, do not soak, your lint-free cloth for this purpose. Finally, wipe off thoroughly and buff with dry lint-free cloth.
- c. Since Series SIXTY Microscope has obsoleted the need for inclination joints, and rack and pinion focusing adjustments, the customer's chore of cleaning and relubricating these nonessential parts have been reduced to nil. All moving parts are protected within the microscope stand and lubricated with permanent type special purpose lubricant. Consequently, disassembly of parts and replacement of these "lifetime" lubricants is unnecessary under normal laboratory working conditions.
- d. Store your microscope in a clean, dry place and keep it covered with the supplied plastic cover when the instrument is not in use.

2. Optical Parts

Eyepieces, objectives, condensers and reflecting optical elements are locked-in to safeguard against tampering, damage, loss and prevent dust from entering into the internal optical system.

Do not clean optical parts unnecessarily. If the specimen image appears to have deteriorated and lacks definition —

a. Check the quality of the specimen preparation by using a better area of the slide or insert a slide of known results or turn the nosepiece turret to another objective.

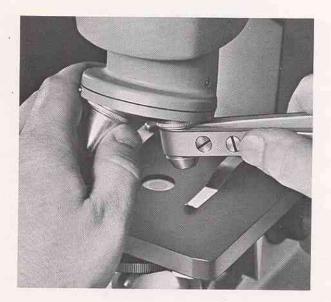
If the image quality is improved by the latter, but not the former — cleaning of the bottom-most lens of the objective is indicated.

b. Blurred specks appearing in the field of view are generally caused by dust, lint or smears contaminating the eyepiece or specimen cover glass. If the specks move upon rotation of the eyepiece, clean the topmost lens of the eyepiece. If the specks move upon the slight displacement of the specimen slide, clean the cover glass.

Glass surfaces should never be touched with the fingers because they will leave a greasy smear and, frequently, corrosive perspiration. If a glass surface definitely requires cleaning —

- c. Dust it off with a small, clean, dry, warmed camel hair brush. Or, blow it off with an aspirator. An all-rubber infant's ear or enema syringe is also ideal for this purpose.
- d. Wipe off with a clean, lint-free soft linen cloth or lens paper moistened slightly with distilled water . . . and carefully wipe dry with circular motion.

- e. If a film persists, repeat step "c" using a mild soap or detergent solution or xylene. Never supersaturate your cloth or lens paper . . . promptly wipe the surface dry before allowing it to air dry.
- f: If the specimen image still does not appear clear, it will be necessary to carefully remove the objective from



its turret by means of a No. K1423 strap-type wrench especially designed for this purpose and available at a nominal charge from the manufacturer.

g. Then, carefully examine the objective with a magnifier to determine the trouble... and clean thoroughly. Recessed lenses can best be cleaned at the outer periphery by using a moistened cotton swab with a slight twirling motion. A soft lint-free cloth or lens paper wrapped around the end of a rounded, soft wooden stick can serve the same purpose.

Objectives and eyepieces are carefully aligned at the factory and must not be taken apart. Entrust this type of work only to authorized AO Instrument Division service dealers or our factory Customer Service Dept.

The Mirror, In-base Illuminator and Condenser are not very sensitive to the presence of dirt. It makes sense, nevertheless, that good housekeeping be exercised on these parts and that they be kept reasonably clean by following the above cleaning methods.

SERIES SIXTY PARTS LIST

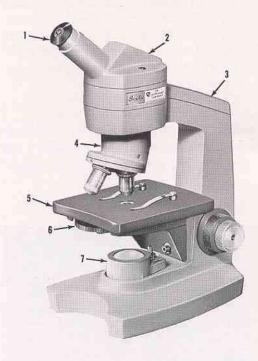
This manual contains a listing of parts and illustrations for the AO Model 60 Microscope. The illustrations are used to identify and locate parts of the equipment and are keyed to the parts list by the use of index numbers. To order a part, identify and locate the part by using the illustrations. Note the index number for the part and cross-reference it to the parts list. The part number, description, and quantity required will be found opposite the index number.

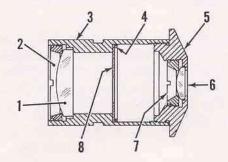
In certain cases, it may be desirable to replace a complete assembly in lieu

of overhauling or rebuilding with detail parts. Where complete assemblies are available, they are indicated by a note in the description column to show which parts they include.

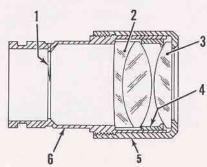
Parts or assemblies should be ordered directly from the AO Instrument Company plant at Buffalo, N.Y., or from any of AO's authorized dealers. When ordering parts, be sure to include a complete description, part number, and correct quantity.

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Cat. No. 160 10X Huygenian Eyepiece with Pointer and Measuring Scale



Cat. No. 161 10X Wide Field Eyepiece with Pointer

Figure 2. Eyepieces

Index No.	Part Number		Quantity
	Cat. No. 160	10X Huygenian Eyepiece with Pointer and Measuring Scale	
1	163-601	Field Lens	1
2	163-3	Retainer	1
2 3	160-53	Tube	1
	160-51	Retaining Ring	1
5	160-52	Eye Cell	1
4 5 6	163-602	Front Lens	1
7	177-2	Retainer	1
8	160-50	Pointer and Measuring Scale	1
	Cat. No. 161	10X Wide Field Eyepiece with Pointer	
1	164-4	Pointer	1
2	164-701	Doublet	1
3	164-603	Front Lens	1
4	164-3	Spacer	1
2 3 4 5	164-2	Cap	1
6	161-50	Tube	1

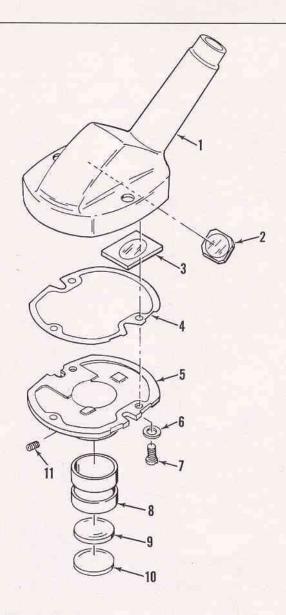


Figure 3. Monocular Body Assembly

Index No.	Part Number	Description	Quantity
	Cat. No. 76	Monocular Body	
1	60-221	Body	1
2	60-613	Mirror, top	1
3	60-609	Mirror, lower	1
4	60-270	Seal, body	1
5	60-271	Plate	1
6	X-51616	Washer	3
7	60-57	Screw	3
	60-856	Telescope Cell Assembly (includes items 8, 9, 10)	1
8	60-65	Cell, telescope	ĩ
9	60-602	Lens, flint	î
10	60-601	Lens, crown	î
11	X-25706	Screw .	î

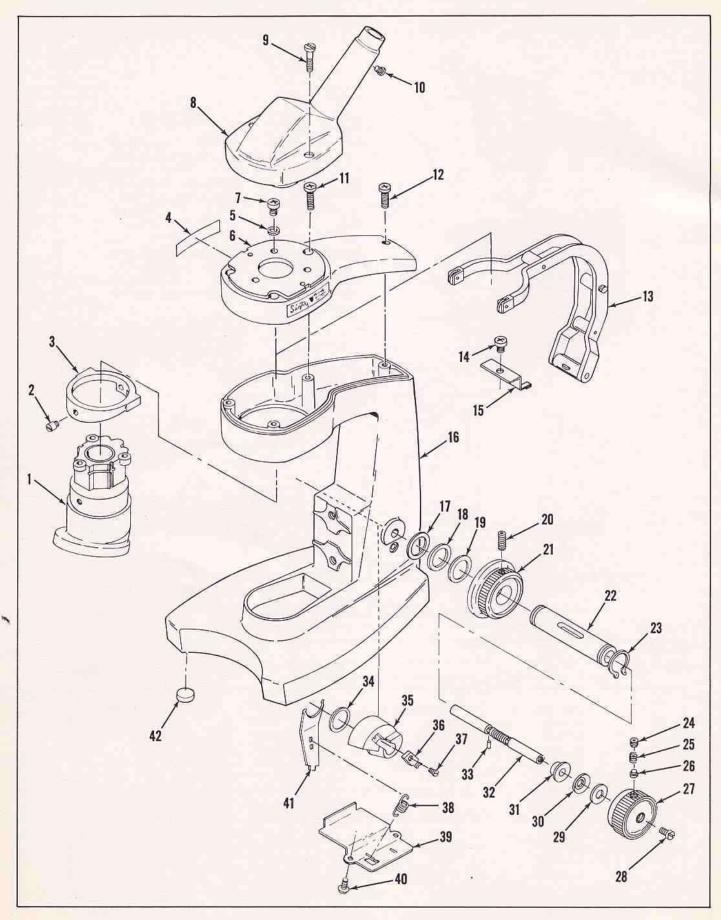


Figure 4. Stand

Figure 4. Stand

Index No.	Part Number	Description	Quantit
1	60-854	Nosepiece and Sleeve Bearing (see figure 5 for breakdown)	1
2	60-48	Screw	2
3	60-47	Ring, lift	
4	60-276	Plate, name	1 2
5	X-50869	Washer	3
6	60-220	Cover, arm	1
6 7	X-29469	Screw	2
8	76-851	Monocular Body Assembly (see figure 3 for breakdown)	3 1
9	X-32570-22	Screw	
10	0308		2
		Screw	1
11	X-38839-2	Screw	3
12	X-38834-11	Screw	1
13	60-501	Lever Assembly	1
14	X-38837-2	Screw	1
15	60-27	Lever, retainer	1
16	60-218	Arm	1
17	01427	Washer	3
18	60-23	Washer, friction	1
	60-105	Washer (used on opposite end)	1 1 1
19	X-50864	Washer	1
20	60-131	Screw	
21	60-11	Knob, coarse adjustment	2 2 1
22	60-134	Tube, coarse adjustment	1
23	X-50370	Washer, Tru-Arc	2
24	60-18	Screw	2
25	60-37		2 2 2
26	60-17	Spring Disa alutah	2
20	60-22	Disc, clutch	
0.77		Spacer (used on opposite end)	2 2
27	60-16	Knob, fine adjustment	
28	60-20	Screw	2
29	01037-3	Washer	1
30	X-50875	Washer, spring	1
31	60-58	Bearing	2
	60-852	Fine Adjustment Screw Stop Assembly (includes items 32, 33)	1
32	60-12	Shaft (order as #60-852 listed above)	1
33	X-50635	Pin, roll	2
34	60-135	Washer	1
35	60-136	Cam	1
36	60-143	1/2 Nut, Delrin	1
37	X-26112	Screw	1
	60-860	Lever Spring Assembly (includes items 38, 39, 41)	1
38	60-66	Spring, cam	1
39	60-64	Bracket, pivot	î
40	X-30716	Screw	2
41	60-144	Lever, cam tension	1
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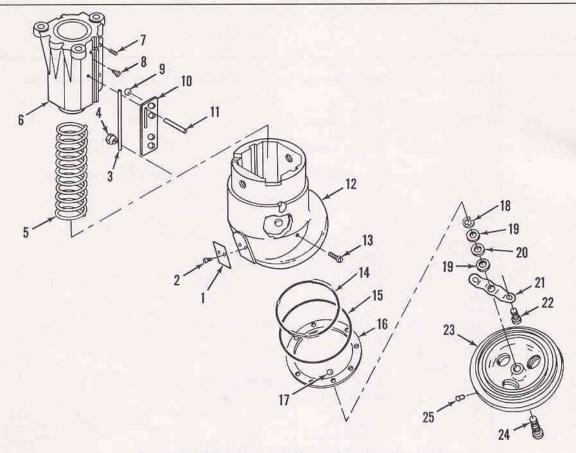


Figure 5. Nosepiece and Sleeve Bearing Assembly

Index No.	Part Number	Description	Quantity
i	253-6	Spring, index	1
1 2	X-34590	Screw	1 2 8 2 1 1 2 2 8 2 2 1 2 2 2 1 2
3	60-41	Rod, bearing	8
3 4	60-32	Nut, taper	2
5	60-72	Spring	1
	60-42	Bearing, sleeve	1
6	X-51578	Screw	2
8	60-31	Screw, rod	2
8	B-11040-339	Bearing, ball	8
10	60-29	Retainer, bearing	2
11	X-50629	Pin, roll	2
12	60-273	Nosepiece, upper	1
13	X-738-2	Screw	2
14	60-36	Race, ball, inner	2
15	60-45	Race, ball, outer	2
16	60-40	Spacer, bearing	
17	18020-348	Bearing, ball	10
18	B-3801-59	Ring, Truarc	1
19	60-53	Washer, retaining	2
20	60-54	Spacer, nylon	1
21	60-44	Retainer	1
22	60-20	Screw	2 1 1 2 1
23	61-1	Nosepiece, bottom, triple (Stock No. 593)	1
	60-68	Nosepiece, bottom, double (Stock No. 592)	1
	62-1	Nosepiece, bottom, quadruple (Stock No. 594)	1
24	60-142	Pin, nosepiece axle	1 2
25	X-10014	Pin	2

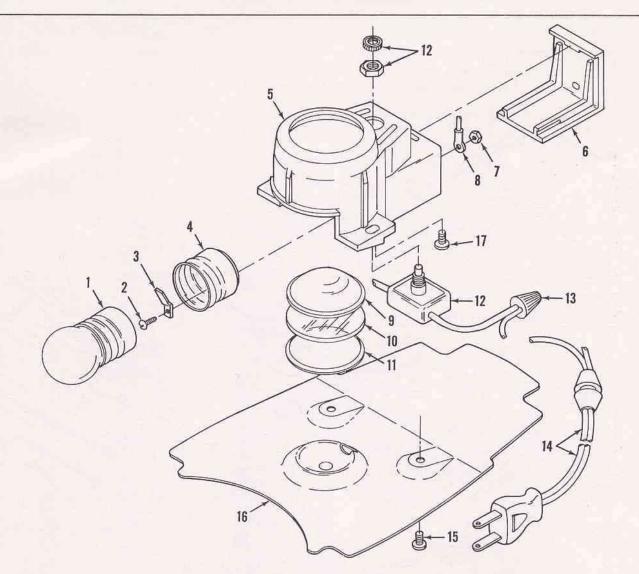


Figure 6. Illuminator Assembly

Index No.	Part Number	Description	Quantity
	Cat. No. 614	Illuminator Assembly	
1	Cat. No. 611	Bulb, 15W,115V (Mfrs. designation 15S11/102)	1
	Cat. No. 613	Bulb, 15W,220V (Mfrs. designation 15S11/101 with medium screw base)	1
2 3	610-12	Screw	3
3	610-9	Connector, terminal	1
4	610-7	Socket, shell	1
4 5 6 7 8	614-10	House, lamp	1
6	614-9	Cover, lamp	1
7	X-8000-2	Nut	3
8	X-50039	Terminal, wire	2
9	610-601	Lens	1
10	614-601	Glass, blue	1
11	X-50882	Ring, retaining	1
12	614-6	Switch, push type (nuts supplied)	1
13	X-50060	Connector, wire	1
14	614-8	Cord Set	1
15	X-30764-2	Screw	2
16	614-7	Cover, base	1
17	X-30765-2	Screw	2

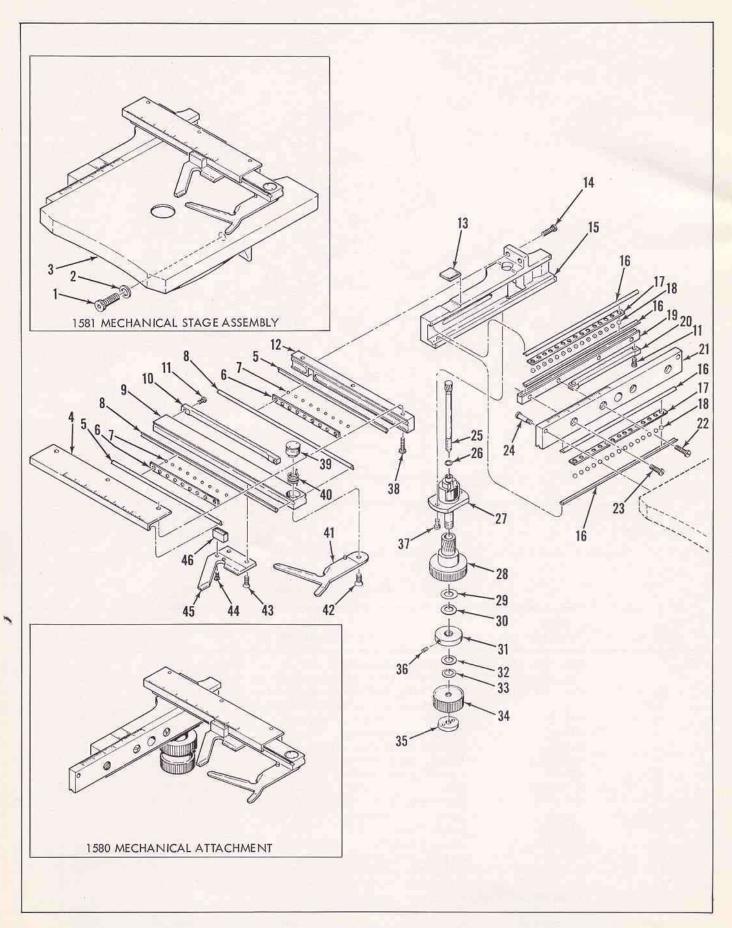


Figure 7. Mechanical Stage

Figure 7. Mechanical Stage

Index No.	Number	Description	Quantity
	Cat. No. 1581	Mechanical Stage Assembly (includes items 1, 2,	
		3 and Cat. No. 1580)	
	Cat. No. 1580	Mechanical Stage Attachment (includes items 4 thru 46)	
1	X-36090	Screw	2
2	X-16090	Washer	2
3	1579-2	Stage	1
4	1580-19	Scale, horizontal	1
5	1580-25	Liner, ball race, short	2
6	1580-26	Retainer, ball	2
7	1580-32	Ball Bearings, 2 mm dia.	18
8	1580-24	Liner, ball race, long	2
9	1580-14	Ball Bearing Slide, horizontal	1
10	1580-21	Rack, horizontal, long	- 1
11	1580-12	Screw	4
12	1580-20	Ball Race, horizontal	1
13	1580-8	Vernier, vertical	1
14	1580-31	Screw	2
15	1580-3	Housing	1
16	1580-6	Liner, ball race, vertical	4
17	1580-7	Retainer, ball	2
18	1580-13	Ball Bearing, 3.2 mm dia.	30
19	1580-5	Ball Bearing Slide, vertical	1
20	1580-9	Rack, vertical, short	1
21 22	1580-4	Ball Bearing Slide, vertical	1
23	1580-11	Screw	1
24	1580-10	Screw	3
25	1580-2 1580-41	Screw Pinion	2
26	1580-42	Washer	1
27	1580-501	Pinion Bearing	÷
28	1580-34	Knob, vertical	1
29	1580-40	Washer, Teflon	1
30	1580-39	Washer, spring	1
31	1580-43	Ring	î
32	1580-33	Washer, Teflon	î
33	1580-37	Washer, spring	1
34	1580-35	Knob, horizontal	î
35	1580-36	Lock Nut	î
36	1580-44	Setscrew	î
37	1580-38	Screw	2
38	1580-27	Screw	3
39	1580-16	Sleeve, bearing	1
40	1580-17	Spring	1
41	1580-15	Slide Holder, movable	î
42	1580-18	Screw	1
43	1580-29	Screw	2
44	1580-30	Screw	2
45	1580-23	Slide Holder, fixed	1
46	1580-22	Vernier, horizontal	1
THSW*		ACT STANSON ASSOCIATION STANSON	

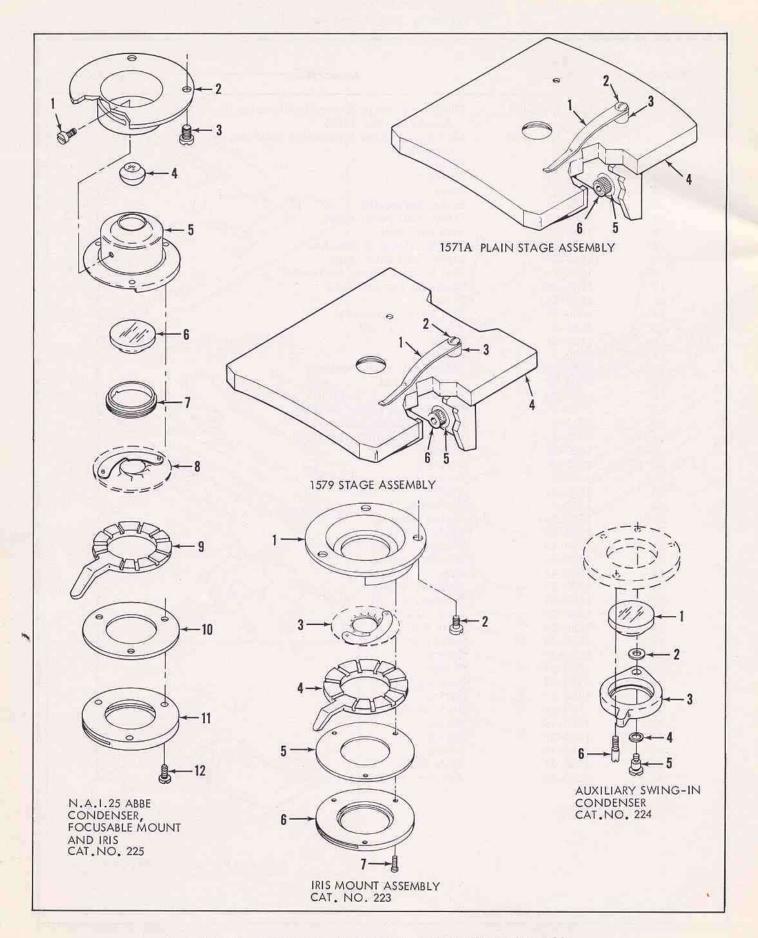


Figure 8. Plain Stage, Condensers, and Iris Mount Assembly

Figure 8. Plain Stage, Condensers, and Iris Mount Assembly

Cat. No. 223	Index No.	Part Number	Description	Quantity
1		Cot No. 222	Trie Manut Assembly	
2	4			
3 324-853				1
4 225-5 Ring, shifting 1 1 1 1 1 1 1 1 1	2			3
Second	3			
Cat. No. 225 N. A. 1. 25 Abbe Condenser, Focusable Mount and Iris	4			
Cat. No. 225 N. A. 1. 25 Abbe Condenser, Focusable Mount and Iris	5			
Cat. No. 225 N. A. 1. 25 Abbe Condenser, Focusable Mount and Iris 1 228-5 Screw 1 3 X-30388-2 Screw 3 225-851 Iris Mount Assembly (includes items 4, 5, 6, 7) 1 4 233-602 Lens, front 1 5 225-2 Mount, iris 1 1 1 1 1 1 1 1 1	6			
1 228-5 Screw 1 2 225-4 Bearing, sleeve 1 3 X-30388-2 Screw 3 225-851 Iris Mount Assembly (includes items 4, 5, 6, 7) 1 4 233-602 Lens, front 1 5 225-2 Mount, iris 1 6 233-601 Lens, back 1 7 225-7 Ring, retaining 1 8 324-853 Iris Leaf Assembly 11 9 225-5 Ring, iris shifting 1 10 223-4 Retainer 1 11 223-3 Holder, blue glass 1 12 0138-4 Screw 2 Cat. No. 1571A Stage, simple, complete 2 1 60-25 Clip, stage 2 2 X-30750-2 Screw 2 2 X-36090 Screw 2 2 X-16090 Washer 2 2 Cat. No	7	0138-4	Screw	3
1 228-5 Screw 1 2 225-4 Bearing, sleeve 3 3 X-30388-2 Screw 3 225-851 Iris Mount Assembly (includes items 4, 5, 6, 7) 1 4 233-602 Lens, front 1 5 225-2 Mount, iris 1 6 233-601 Lens, back 1 7 225-7 Ring, retaining 1 8 324-853 Iris Leaf Assembly 11 9 225-5 Ring, iris shifting 1 10 223-4 Retainer 1 11 223-3 Holder, blue glass 1 12 0138-4 Screw 2 Cat. No. 1571A Stage, simple, complete 2 1 60-25 Clip, stage 2 2 X-30750-2 Screw 2 3 60-24 Bushing, stage clip 2 4 1570-2 Stage 1 2 <		Cat. No. 225	N. A. 1.25 Abbe Condenser, Focusable Mount and Iris	
2 225-4 Bearing, sleeve	1			1
3	2			1
225-851	3			3
4 233-602 Lens, front 1 5 225-2 Mount, iris 1 6 233-601 Lens, back 1 7 225-7 Ring, retaining 1 8 324-853 Iris Leaf Assembly 11 9 225-5 Ring, iris shifting 1 10 223-4 Retainer 1 11 223-3 Holder, blue glass 1 12 0138-4 Screw 1 1 60-25 Clip, stage 2 2 X-30750-2 Screw 2 3 60-24 Bushing, stage clip 2 4 1570-2 Stage 1 5 X-16090 Washer 2 2 X-36090 Screw 2 2 20-851 Lens Assembly (includes items 1 and 3) 1 1 231-602 Lens, back 1 2 01012-1 Washer 1 3 230-2 Cell 1 4 01224 Washer				
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4 1579-2 Stage 1 5 X-16090 Washer 2 6 X-36090 Screw 2	3			2
5 X-16090 Washer 2 6 X-36090 Screw 2				1
6 X-36090 Screw 2	5	X-16090		2
			Screw	2

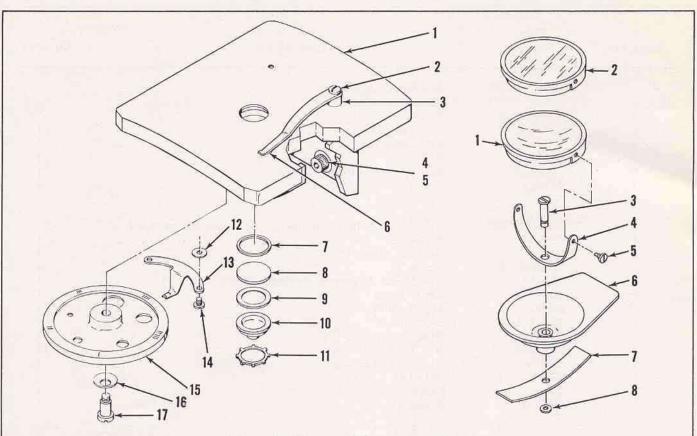
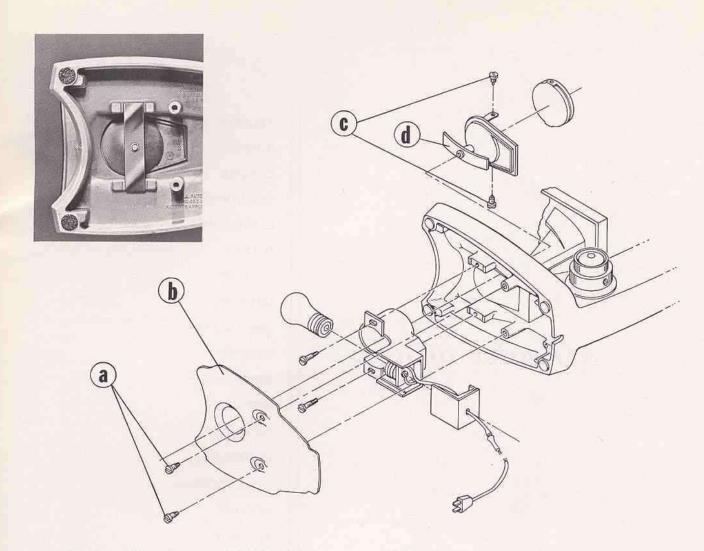


Figure 9. Stage and Mirror Assemblies

Index No.	Part Number	Description	Quantity
	Cat. No. 1570A	Stage Assembly with Condenser	1
1	1570-2	Stage	1
2	X-30750-2	Screw	2
2 3	60-24	Bushing, stage clip	2 2
4	X-16090	Washer	2
5	X-36090	Screw	
6	60-25	Clip, stage	2 2
7	227-4	Gasket	1
8	227-602	Window	1
9	227-2	Diaphragm	1
10	227-601	Condenser	1
11	X-50878	Ring, retaining	1
12	220-5	Washer	2
13	220-3	Spring, index	1
14	X-38827-2	Screw	2
15	220-1	Disc, diaphragm	1
16	X-50695	Washer, spring	1
17	220-4	Screw	1
	Cat. No. 205	Concave Mirror Assembly, complete	1
	Cat. No. 217	Plano-Concave Mirror Assembly, complete	1
1	205-851	Mirror, concave, mounted in frame	1
2	217-851	Mirror, Plano-concave, mounted in frame	1 '
3	205-5	Pin	1
4	205-3	Fork	1
5	205-4	Screw, pivot	2
6	205-2	Mount	0 1
7	205-6	Spring	1
8	B-3801-59	Ring, retaining	1



In-Base Illuminator, Model 614

The In-base Illuminator consists of a 115 volt, 15 watt bulb, ground glass condensing lens, blue glass light filter . . . all encased within a durable plastic housing with convenient push button switch. Two self-threading screws are also supplied to securely attach the illuminator to appropriate lugs located within the under side of the microscope base; plus a shorter set of two screws to retain the one-piece base cover plate and chromed reflector.

Model 614 In-base Illuminator is designed specifically for Series SIXTY microscopes to form an integral part of the instruments and assure optimum performance at all magnifications. Plugs directly into any standard 110-115v outlet.

To replace lamp bulb: Carefully place the microscope on its side, disconnect cord from

outlet, remove screws (a) and base cover plate (b), unscrew bulb. For maximum efficiency always replace with same type bulb (manufacturer's designation, 15S11/102) available at any electrical retail outlet.

Mirror Assemblies, Models 205, 217

To increase vertical tilting tension of the mirror: remove screws (c) and mirror... bend fork inward uniformly as required with fingertips and reassemble.

To remove entire mirror assembly from the microscope base: carefully place the microscope on its side, retain a firm grip on the instrument, flex *ends* of flat stock mirror spring (d) outward . . . rotate it 90 degrees and withdraw the assembly. Reverse steps to insert.

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