

# AO DESK-TYPE METALLOGRAPH

No. 2400A — FOR ROUTINE CONTROL

## FEATURES

- Complete instrument operation from sitting position
- Coupled visual and photographic systems
- Specially designed "Apergon" objectives
- Quadruple revolving objective turret
- Built-in flat field photographic eyepieces
- "Autofocus" stop



Close-up shows large square graduated ball-bearing mechanical stage.



AO Desk-Type Metallograph, No. 2400A

**T**HE AO Desk Type Metallograph, Model 2400A, provides the metallographer with a control instrument of maximum efficiency. Its unique design and styling permits *all* operational functions to be performed from a sitting position.

The parfocality of the visual and photographic optical systems is patented and is one of the many exclusive AO features. When the image of the specimen is in focus

through the visual eyepiece, it is also in sharp focus in the camera and ready for instant recording.

Parfocality of the specially designed Americote "Apergon" objectives, quadruple revolving objective turret, in addition to prefocused photographic eyepieces on positioning slide, greatly simplify changing from one magnification to

another. A fixed positioning "Autofocus" stop is provided, against which the mechanical stage is lowered. It prevents any damage to objective front lens elements, yet permits rotation of the objectives on the turret into the optical path. Because "Apergon" objectives are parfocal\*, the stage remains in this fixed position; only slight touch-up of the focusing is necessary with the fine adjustment when chang-

ing from one objective to another. All objectives, visual and photographic eyepieces, as well as camera bellows setting, are engraved in terms of standard A.S.T.M. magnifications.

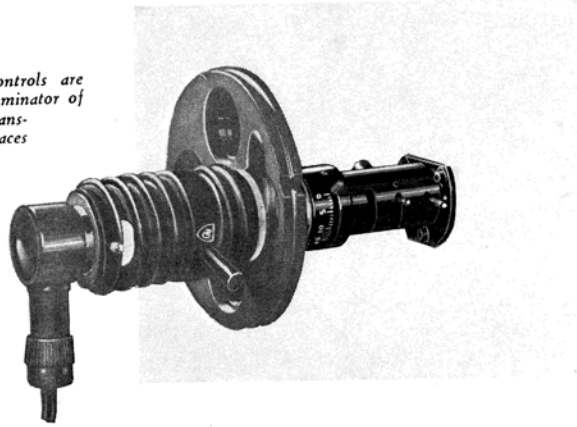
Factory adjustment with special optical aligning fixtures, coupled with sturdy construction of the instrument, assures years of satisfactory, trouble-free operation.

#### STAGE

This instrument is supplied with a large, stable, 6 $\frac{3}{4}$ " square, graduated ball-bearing mechanical stage. Basic equipment includes two stage insert plates which accommodate different sized specimens. A specimen holder with guide and index mark for relocation purposes is supplied for either

1", 1 $\frac{1}{4}$ " or 1 $\frac{1}{2}$ " Bakelite-mounted specimens. The large-sized knurled mechanical adjustment knobs have ample finger clearance and are positioned at a convenient height for operation when the right elbow is resting comfortably on the desk top.

*Aperture and field diaphragm controls are easily accessible in the Vertical Illuminator of the No. 2400A. Increased light transmission and faultless optical surfaces are accomplished by the inclusion of a sealed-in coated plano-glass reflector.*



#### BASIC AO METALLOGRAPH NO. 2400A CONSISTS OF:

Large inverted microscope with square graduated ball-bearing mechanical stage; rack-and-pinion coarse adjustment with "Autofocus" stop; quadruple revolving dual-cone objective turret; dust-proof vertical illuminator with field and aperture diaphragms, sealed-in reflector, Americote optics, for use with AO "Apergon" infinity-corrected objectives; ball-bearing fine adjustment; binocular body; parfocal visual and photographic systems enabling final focusing for photography through the visual system; quadruple filter turret with blue, green, daylight and opal filters; visual illuminator; 3 pairs of visual eyepieces; 1" diameter and oval stage insert plates; universal specimen holder and

locating device; positioning slide with 4 photographic eyepieces covering range from 50X to 1500X with magnification scale for instant selection; built-in 5" x 7" camera, located in front of instrument, with heavy-duty shutter, adjustable bellows with magnification scale; steel desk with provision for built-in control panel and electrical accessories, fitted with 1 accessory drawer and 2 additional storage drawers, adjustable chair of chrome-finish metal, plastic-covered upholstery. The instrument is 53" high from floor to top of instrument, 24" wide and 53 $\frac{1}{4}$ " long. The weight of the instrument, unpacked, is 350 pounds.

**Note:** The basic equipment does not include high intensity illuminator and objectives.

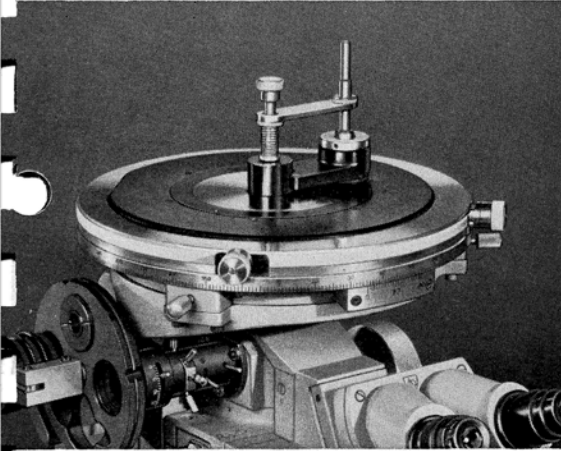
\* all except the 50X

# AO RESEARCH METALLOGRAPH

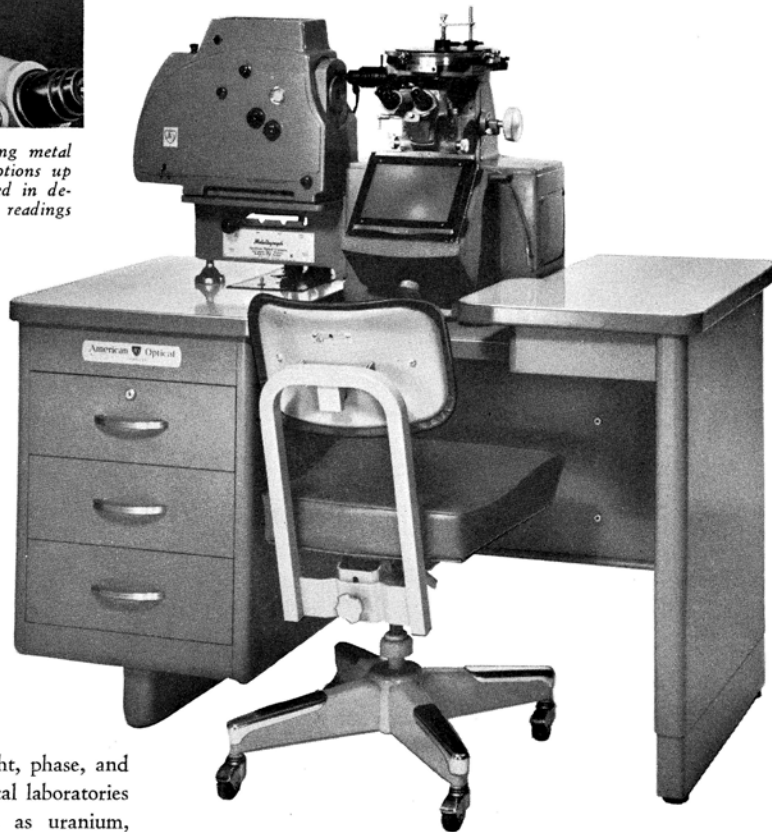
No. 2400P

## FEATURES

- Same basic features as 2400A
- Phase and polarizing equipment
- Circular, heavy-duty ball bearing mechanical stage
- Oblique illuminating prism

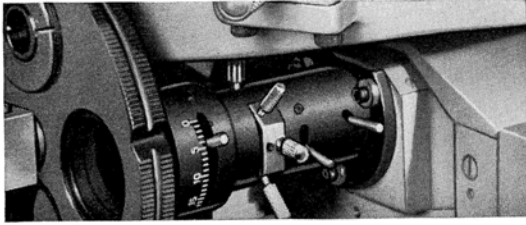


The large heavy-duty, research-type revolving metal mechanical stage has built-in coordinate motions up to  $\pm 10$  mm in either direction. Graduated in degrees on the periphery, the vernier permits readings to within 1 minute of arc.



AO Desk-Type Metallograph No. 2400P, for Research.

THE AO Research Metallograph embodies practically all features of the 2400A, for bright field work — with the added advantages of polarized light, phase, and oblique illumination. Those metallurgical laboratories dealing with anisotropic metals such as uranium, beryllium, zirconium, titanium, etc., will find polarized light of great advantage. It is also useful for identifying non-metallic inclusions. The addition of phase makes it possible to distinguish minute differences in level of areas within the specimen.



A permanently aligned Polaroid polarizer is built into one aperture of the filter turret. A special plano-glass reflector, with thin metal coating, is used in the Vertical Illuminator.

### POLARIZED LIGHT

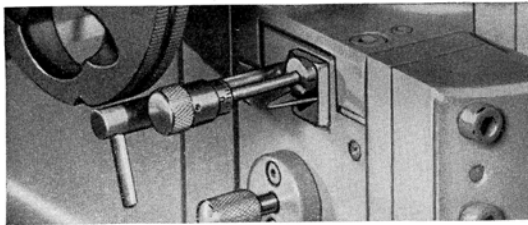
The high quality Polaroid polarizer is permanently aligned and built into one aperture of the filter turret. The Polaroid analyzer is located on a built-in slide with graduated 360° rotating mount. It has click stops at every 45°. A full wave polarizing compensator in rotating mount is furnished as standard equipment, and provides a means of converting very slight differences in birefringence or phase shift into striking color differences or enhanced contrast. The revolving filter turret accommodates, in addition to the polarizer, blue, green, daylight and opal filters — also supplied as standard. A specially designed plano-glass reflector with thin metal coating is used in the Vertical Illuminator which renders plane polarized light free from disturbing elliptical polarization.

### PHASE

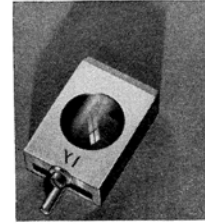
When using phase, a centerable annular diaphragm in special mount is inserted in the Vertical Illuminator. A corresponding diffraction plate, built into the analyzer slide, is moved into the optical path. A telescopic eyepiece, supplied as standard, is used to check concentricity and focus of these two optical elements. The annular diaphragm is focused sharply on the diffraction plate by a focusable lens in the Vertical Illuminator.

### OBLIQUE ILLUMINATION

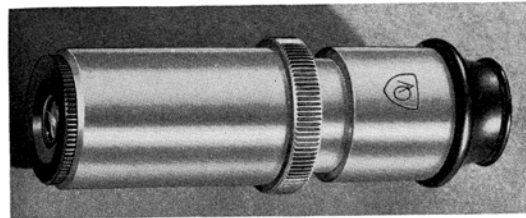
It has been standard practice on competitive instruments to provide oblique illumination by displacing the aperture



Polaroid analyzer is on a built-in slide in a graduated, rotating mount. Rotating through 360°, it has a click stop at every 45°. A diffraction plate, corresponding to a centerable annular diaphragm, is built into the analyzer slide and can be moved into the optical path.



A full wave polarizing compensator, in rotating mount, furnishes an effective means of converting slight differences in birefringence or phase shift into striking color differences.



Telescopic eyepiece is used to check concentricity and focus the annular diaphragm and diffraction plate.

diaphragm. AO has avoided this construction because of the danger of inadvertently having the aperture diaphragm off center when truly vertical illumination is desired. For good vertical illumination it is essential to maintain centration of the aperture diaphragm beyond the accuracy reliably provided by a detent device. AO provides the same end result by *optically* decentering the aperture diaphragm with a prism mounted in an accessory slide which fits the aperture slot of the Vertical Illuminator. Perfect centration of the aperture diaphragm, accomplished at the factory with sensitive optical alignment fixtures, is thereby assured. Proper orientation of the specimen with respect to the obliquity provided is accomplished by rotating the stage. Oblique Illuminating Prism is furnished as standard equipment.

### STAGE

The Research Metallograph is supplied with a large, heavy-duty, research-type circular ball-bearing mechanical stage. 8" in diameter, it rotates in a ball-bearing mount and is conveniently centerable through two adjustments located at 120° to each other. Graduated in degrees on the periphery, the vernier permits readings to 1 minute of arc. It has built-in coordinate motions permitting movement up to ± 10 mm in either direction. The two knobs for making these coordinate adjustments are graduated in tenths of a millimeter — one complete revolution moves the stage 1 mm. With this stage the metallographer has a choice of free rotation, controlled friction, or firm lock.

## BASIC METALLOGRAPH MODEL NO. 2400P CONSISTS OF:

Large inverted microscope with circular, rotary, graduated ball-bearing mechanical stage with built-in coordinate motions; rack-and-pinion coarse adjustment with "Autofocus" stop; quadruple revolving dual cone objective turret; dust-proof vertical illuminator with field and aperture diaphragm and slot to receive compensators and phase annular diaphragms; sealed-in coated, plano-glass reflectors, full wave compensator in rotating mounts; oblique illumination prism; phase annulus; built-in Polaroid analyzer and diffraction plate; centering telescope. Polaroid analyzer rotatable through 360° with graduations and click stop every 45°. Americote optics, for use with AO "Apergon" infinity-corrected strain-free objectives; ball-bearing fine adjustment; binocular body; parfocal visual and photographic systems enabling final focusing for photography through the visual

system; quadruple filter turret with blue, green, daylight and opal filters; Polaroid polarizer, visual illuminator; 3 pairs of visual eyepieces; 1" diameter and oval stage insert plates; universal specimen holder and locating device; positioning slide with 4 photographic eyepieces covering range from 50X to 1500X with magnification scale for instant selection; built-in 5" x 7" camera, located in front of instrument, with heavy-duty shutter; adjustable bellows with magnification scale; steel desk with provision for built-in control panel and electrical accessories, fitted with 1 accessory drawer and 2 additional storage drawers, adjustable chair of chrome-finish metal, plastic-covered upholstery. The instrument is 53" high from floor to top of instrument, 24" wide and 53¼" long. The weight of the instrument is 350 pounds, unpacked.

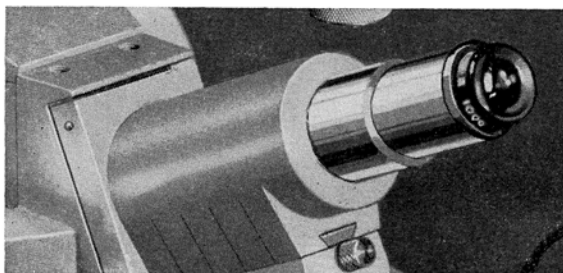
**Note:** The basic equipment does not include high intensity illuminator and objectives.

## Key Features and Accessories Common to Both Model Metallographs

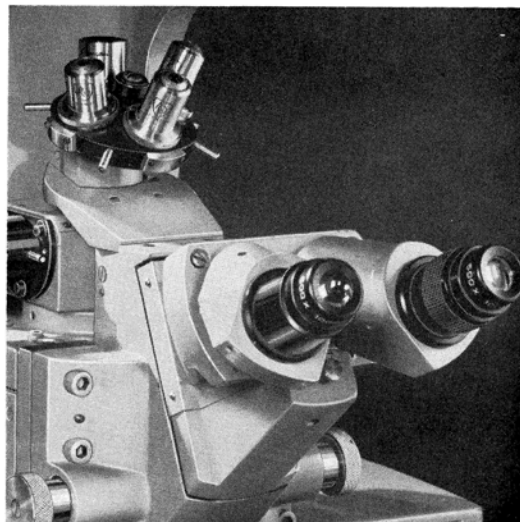
### MATCHED OPTICS

Exact mathematical computations and meticulous workmanship lead to unexcelled performance of the infinity-corrected "Apergon" objectives. Coupled with matched photographic and visual eyepieces, they provide excellent definition with striking flatness of field. Achromatically balanced for high image contrast and color correction, they have the proper numerical aperture for each magnification. Objectives and eyepieces are engraved with standard A.S.T.M. magnifications (from 50X to 1500X) so that the correct combination is always used for the best possible result. A strain-free series of objectives for the same magnifications is offered for use with the Research Metallograph No. 2400P.

In order to provide increased contrast and transmission, all air-glass surfaces of objectives, visual and photographic eyepieces, and all optical components in the instrument have non-reflective, hard surface coatings known as Americote.



*Monocular body is optional.*



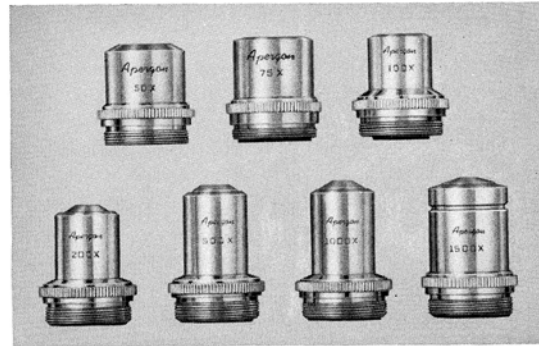
*A quadruple, revolving dual cone objective turret simplifies changing from one objective to another. View also shows binocular body with visual eyepieces.*

### PHOTOGRAPHIC EYEPIECES

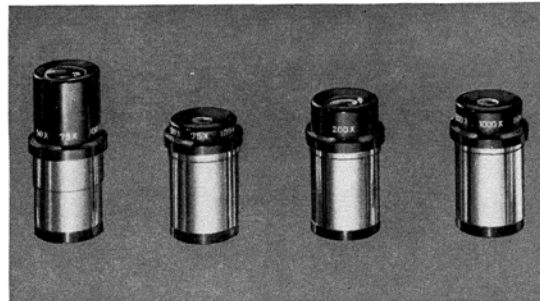
A series of four matching photographic eyepieces, yielding extremely flat fields, are mounted on a horizontal dovetail slide within the instrument. They are operated by external control. Each is protected from dust by a plano-glass cover plate for easy cleaning. Proper selection of photographic eyepieces with the corresponding objectives is assured through a plate engraved in terms of standard A.S.T.M. magnifications located directly under the control lever. Both the visual and photographic optical systems are parfocal and parcentered at all magnifications.

### VISUAL EYEPIECES

Visual eyepieces are offered to cover three different ranges of magnification—from 50X to 1500X. Manufacturing specifications are maintained to such close tolerances that any two of the same magnification make an identical pair.



*Infinity-corrected "Apergon" objectives achieve excellent definition with extreme flatness of field.*



*Visual eyepieces are manufactured to such close tolerances that pairing is unnecessary.*

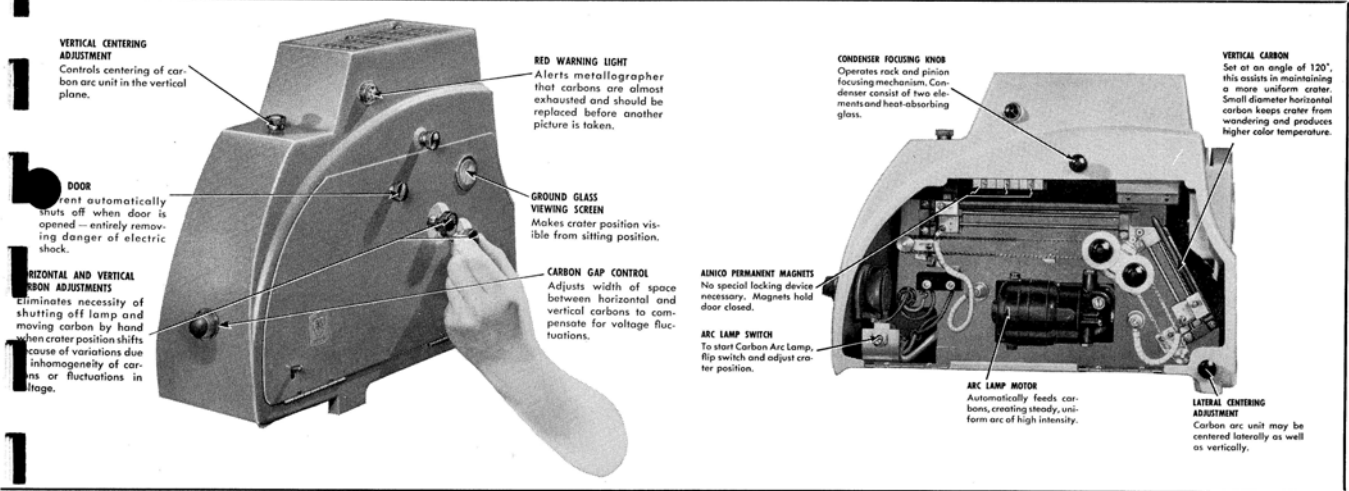


*Control lever above A.S.T.M. magnification scale permits instant selection of desired photographic eyepieces.*



*Photographic eyepieces are mounted on dovetail slide within the instrument. Operated by external control, they are easily accessible through camera aperture. (Normally, it is not necessary to remove side plate of the instrument.)*

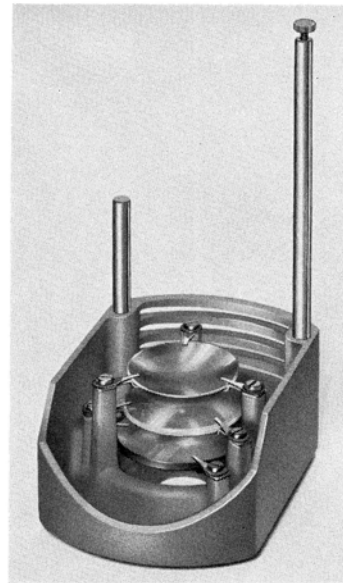
## ILLUMINATING SYSTEM

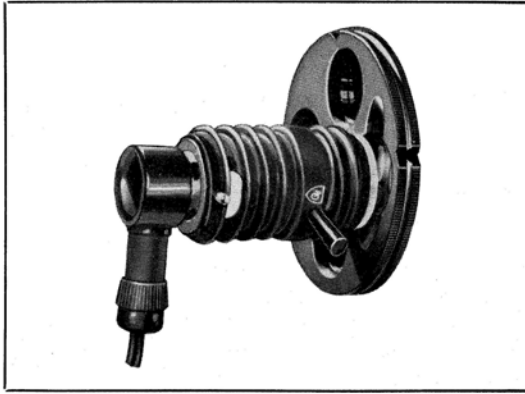


### MOTOR-DRIVEN CARBON ARC ILLUMINATOR

This highly intense light source, available for both 110 volt, 60 cycle A.C. and 110 volt D.C., decreases photographic exposure time. The 120° position of the carbons, in addition to the use of a thin horizontal carbon, makes operation with alternating current highly satisfactory.

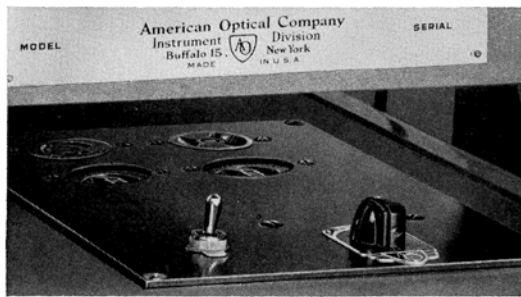
A new, three-element condensing system with heat absorbing glass in a rack-and-pinion focusing mount, furnishes improved, extremely even illumination. The Arc Illuminator ballast is mounted on a ceramic panel fastened to the rear of the desk well.





#### VISUAL ILLUMINATOR

Furnished as standard equipment, this built-in illuminator is entirely adequate for all visual observation except in polarized light. It uses a 6 volt tungsten lamp. The light intensity is controlled by a variable transformer built into the desk control panel. There is ample clearance for the visual illuminator to swing in or out of position, even when Carbon Arc Illuminator is in use.



#### CONTROL PANEL

A black metal control panel is located on the left side of the desk unit. It accommodates an off-and-on switch, adjustable rheostat for the visual illuminator, and extra outlet for a desk illuminator. Outlet plugs to correspond with the illuminator selected are also included.

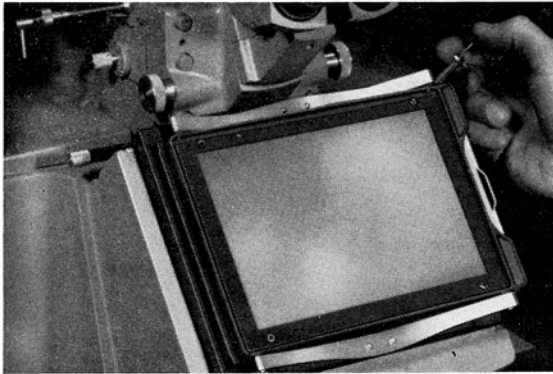
#### PHOTOMICROGRAPHIC CAMERA

The compact camera unit is located directly in front of the metallographer when seated. It has a standard 5" x 7" camera back with a Fresnel lens viewing screen to allow composition of the picture. The camera back will accept 5" x 7" film holders. Includes heavy-duty shutter with cable release and adjustable speeds. Calibrated scale on left side clearly indicates position of enclosed bellows in order to obtain standard A.S.T.M. magnifications with corresponding objective and photographic eyepiece—another exclusive AO patented feature.



*Convenient, functional design of instrument offers ease and comfort to operator for studying viewing screen from sitting position. All controls are near at hand.*





*Standard 5" x 7" camera back has heavy-duty shutter with cable release and adjustable speeds.*

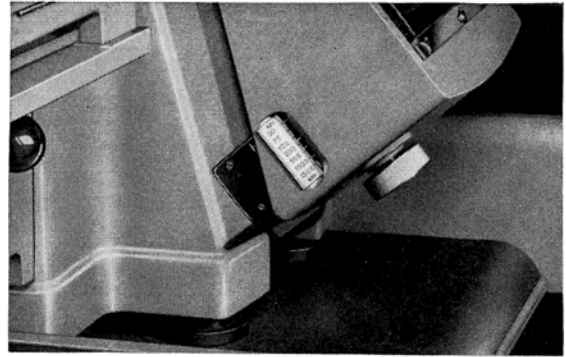
#### **POLAROID LAND CAMERA**

A Polaroid Land Camera, offered as an accessory item, fits over the camera aperture in place of the viewing screen and permits rapid, on-the-spot production of photomicrographic prints. Resultant magnifications at Polaroid Land Camera film plane vary from calibrated values inscribed into bellows scale, but, can be readily determined or supplied on request.

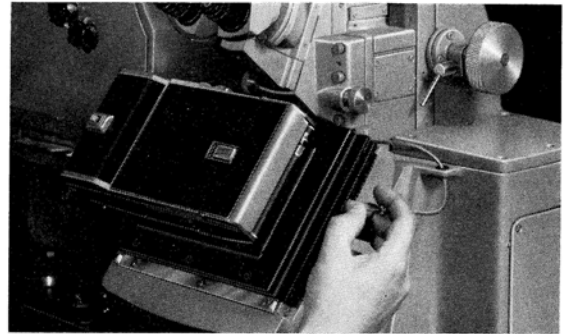
#### **GRAIN SIZE AND CASE DEPTH MEASUREMENTS**

On both models of the AO Metallograph, ferrous and non-ferrous grain size measurements are made directly by comparison between the image on the camera viewing screen and a plastic grain-size chart placed over it. One chart contains 8 reproductions of A.S.T.M. standard grain sizes for ferrous metals. Two additional charts are supplied to cover complete range of grain size for copper-base alloys.

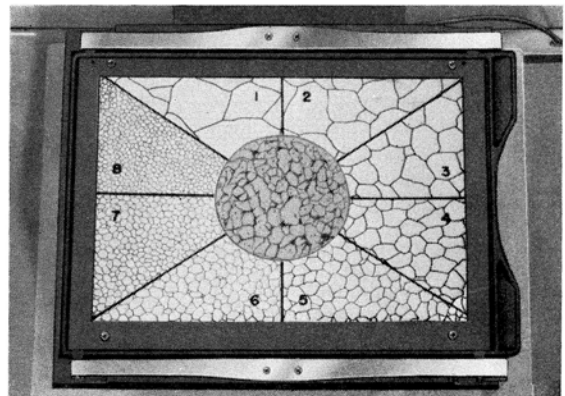
An accessory micrometer rule #2423 enables case depth and other linear measurements to be determined directly on the viewing screen. The use of a stage micrometer is unnecessary for calibration purposes as all AO Metallographs are pre-calibrated at the factory.



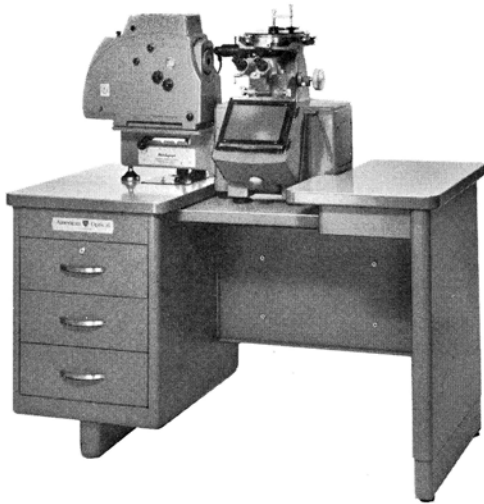
*Calibrated camera magnification scale with A.S.T.M. markings.*



*Polaroid Land Camera attached to camera aperture.*

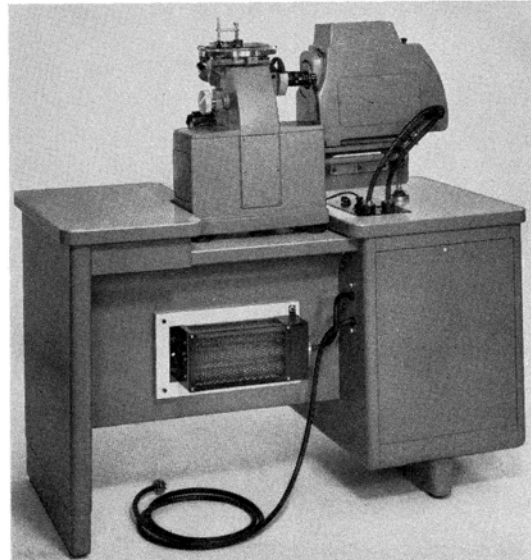


*Grain-size measurement chart.*

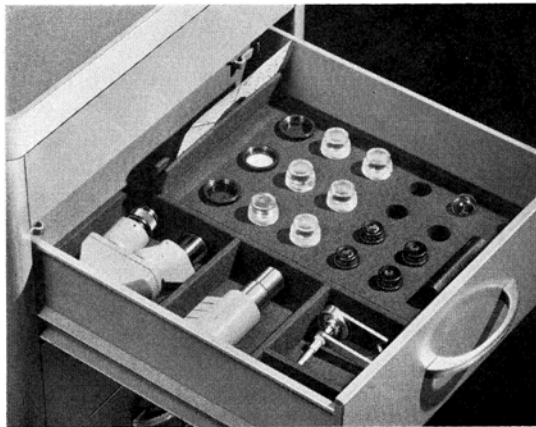


**DESK UNIT**

The compact steel desk unit, of conventional height, has ample working areas. Spacious storage facilities are provided by a bank of three drawers. The top drawer is felt-lined and fitted to accommodate eyepieces, objectives, bodies, filters and other accessories. Partitioned spaces are also provided for additional supplies and equipment regularly used.



*Back of desk unit is neat and uncluttered. Built-in arc illuminator ballast eliminates disorderly wiring.*



*Fitted accessory drawer.*



*Rubber shock absorbers, located between the instrument assembly and the desk unit, effectively deaden high-frequency vibrations. These are supplied as standard.*

## BASIC SPECIFICATIONS

### Model No. 2400A

Large inverted microscope with square graduated ball-bearing mechanical stage; rack-and-pinion coarse adjustment with "Autofocus" stop; quadruple revolving dual cone objective turret; dust-proof vertical illuminator with field and aperture diaphragms, sealed-in reflector. Americote optics, for use with AO "Apergon" infinity-corrected objectives; ball-bearing fine adjustment; binocular body; parfocal visual and photographic systems enabling final focusing for photography through the visual system; quadruple filter turret with blue, green, daylight and opal filters; visual illuminator; 3 pairs of visual eyepieces; 1" diameter and oval stage insert plates; universal specimen holder and locating device; positioning slide with 4 photographic eyepieces covering range from 50X to 1500X with magnification scale for instant selection; built-in 5" x 7" camera, located in front of instrument, with heavy duty shutter; adjustable bellows with magnification scale; steel desk with provision for built-in control panel and electrical accessories, fitted with 1 accessory drawer and 2 additional storage drawers, adjustable chair of chrome-finish metal, plastic-covered upholstery. The instrument is 53" high from floor to top of instrument, 24" wide and 53 1/4" long. The weight of the instrument is 350 pounds, unpacked.

Note: The basic equipment does not include high intensity illuminator and objectives. Price.....\$5976.00

### Model No. 2400P

Large inverted microscope with circular, rotary, graduated ball-bearing mechanical stage with built-in coordinate motions; rack-and-pinion coarse adjustment with "Autofocus" stop; quadruple revolving dual cone objective turret; dust-proof vertical illuminator with field and aperture diaphragm and slot to receive compensators and phase annular diaphragms; sealed-in coated, plano-glass reflectors, full wave compensator in rotating mounts; oblique illumination prism; phase annulus; built-in Polaroid analyzer and diffraction plate; centering telescope. Polaroid analyzer rotatable through 360° with graduations and click stop every 45°. Americote optics, for use with AO "Apergon" infinity-corrected strain-free objectives; ball-bearing fine adjustment; binocular body; parfocal visual and photographic systems enabling final focusing for photography through the visual system; quadruple filter turret with blue, green, daylight and opal filters; Polaroid polarizer, visual illuminator; 3 pairs of visual eyepieces; 1" diameter and oval stage insert plates; universal specimen holder and locating device; positioning slide with 4 photographic eyepieces covering range from 50X to 1500X with magnification scale for instant selection; built-in 5" x 7" camera, located in front of instrument, with heavy-duty shutter; adjustable bellows with magnification scale; steel desk with provision for built-in control panel and electrical accessories, fitted with 1 accessory drawer and 2 additional storage drawers, adjustable chair of chrome-finish metal, plastic-covered upholstery. The instrument is 53" high from floor to top of instrument, 24" wide and 53 1/4" long. The weight of the instrument is 350 pounds, unpacked.

Note: The basic equipment does not include high intensity illuminator and objectives. Price.....\$7456.00

## Accessories

Catalog Number	Description	Price
<b>PHOTOGRAPHIC ILLUMINATORS</b>		
2434	Motor-driven, automatic-feed Arc Illuminator complete with desk control panel, rheostat and wiring for 110 volt D.C. Complete with 50 sets of carbons .....	\$575.00
2435	Same as No. 2434 but 110 volt, 60 cycle A.C. ....	575.00
<b>OBJECTIVES (For Model 2400A)</b>		
C2407	"Apergon" Americote objective for 50X .....	35.00
C2401	"Apergon" Americote objective for 75X .....	53.00
C2402	"Apergon" Americote objective for 100X .....	75.00
C2403	"Apergon" Americote objective for 200X .....	133.00
C2408	"Apergon" Americote objective for 500X .....	200.00
C2405	"Apergon" Americote objective for 1000X .....	237.00
C2406	"Apergon" Americote objective for 1500X oil immersion .....	390.00

Catalog Number	Description	Price
<b>STRAIN FREE OBJECTIVES (For Model 2400P)</b>		
C2479	"Apergon" Americote objective for 50X .....	\$ 50.00
C2480	"Apergon" Americote objective for 75X .....	69.00
C2481	"Apergon" Americote objective for 100X .....	102.00
C2482	"Apergon" Americote objective for 200X .....	148.00
C2488	"Apergon" Americote objective for 500X .....	225.00
C2484	"Apergon" Americote objective for 1000X .....	265.00
C2485	"Apergon" Americote objective for 1500X oil immersion .....	420.00
<b>PHOTOGRAPHIC EYEPIECES SUPPLIED WITH 2400A, 2400P</b>		
C2412	Photographic eyepiece for 50X-75X-100X .....	29.00
C2411	Photographic eyepiece for 200X .....	56.00
C2413	Photographic eyepiece for 500X .....	85.00
C2410	Photographic eyepiece for 1000X-1500X .....	56.00
<b>VISUAL EYEPIECES</b>		
C2415	Visual eyepiece for 50X-75X-100X .....	18.00
C2419	Visual eyepiece for 50X-75X-100X High Eyepoint (Supplied with 2400A, 2400P) .....	29.00
C2417	Visual eyepiece for 200X (Supplied with 2400A, 2400P) .....	40.00
C2416	Visual eyepiece for 500X-1000X-1500X (Supplied with 2400A, 2400P) .....	43.00
NOTE: For binocular observation 2 of each are supplied.		
<b>BODY TUBES</b>		
C2430	Binocular body, Americote optics .....	320.00
2431	Monocular body tube .....	25.00
<b>STAGE INSERT PLATES AND SPECIMEN HOLDERS</b>		
2456	Stage plate 3/4" diameter aperture .....	14.00
2457	Stage plate, recessed, for 1" Bakelite-mounted specimens .....	14.00
2458	Stage plate for 1" diameter aperture (supplied with 2400A and 2400P) .....	14.00
2459	Stage plate, recessed, for 1 1/4" Bakelite-mounted specimens .....	14.00
2462	Stage plate, recessed, for 1 1/2" Bakelite-mounted specimens .....	14.00
2463	Stage plate oval aperture (supplied with 2400A and 2400P) .....	14.00
2471	Universal specimen holder and locating device for 1", 1 1/4", 1 1/2", Bakelite-mounted specimens for 2400A, 2400P .....	36.00
<b>CAMERA ACCESSORIES</b>		
2445*	5" x 7" Viewing Screen & Camera Back (Supplied with #2400A and #2400P) .....	80.00
2475	Land Polaroid Camera Attachment to fit 5" x 7" opening in place of standard double plate holder .....	175.00
K1427*	4" x 5" Adapter, accepts 4" x 5" film or plate holders and Polaroid #500 Back .....	50.00
*Please Note: 4" x 5", 5" x 7" film or plate holders and Polaroid #500 Back are not available from AO-ID. Contact your laboratory or photographic supplier for such items.		
<b>CARBONS AND REPLACEMENT BULBS</b>		
2437	Horizontal carbon (A.C. and D.C.) — box of 50 .....	6.90
2438	Vertical carbon (D.C.) — box of 50 .....	8.00
2439	Vertical carbon (A.C.) — box of 50 .....	8.00
360	Lamp bulb, A.C., 6.5 volts, 2.75 amperes for visual illuminator.....	1.02
2477	Lamp bulb, D.C., 12.8 volts, 1.07 amperes for visual illuminator.....	.50
<b>EXTRA FILTERS</b>		
2443	Yellow Filter, with cell .....	14.00
2444	Red Filter, with cell .....	14.00
<b>MEASURING ACCESSORIES</b>		
2423	Micrometer rule for case depth and linear measurements graduated directly in thousandths and ten-thousandths of an inch .....	39.00
2515	Micrometer eyepiece to read .0010" per scale division when used with 100X objective .....	38.00

## AO INSTRUMENT COMPANY

### BUFFALO, NEW YORK 14215

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