

INSTRUCTION MANUAL

MODEL

ML-POL

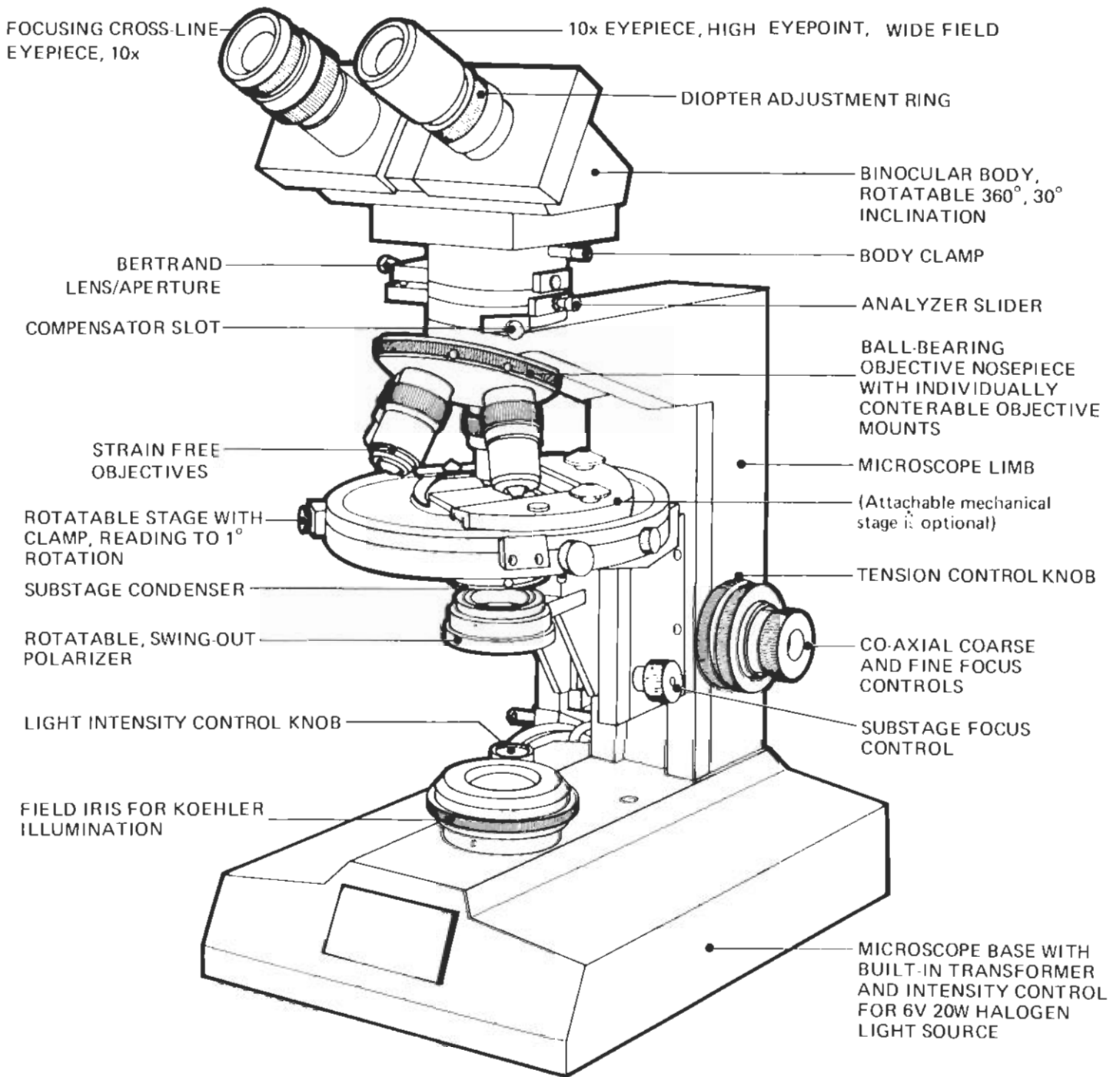
POLARIZING MICROSCOPE

Including information on asbestos identification and counting



MEIJI LABAX CO.,LTD.

Tokyo Japan



ML-POL-B

1 UNPACKING, ASSEMBLY, PREPARATION FOR USE

1-1 UNPACKING

All MEIJI LABAX microscopes are usually supplied in an expanded polystyrene, 2-part case and this should be used for storage, possible transport in the future, etc. If your order includes a wooden storage cabinet, release the fixing screws holding the limb and base into the cabinet and withdraw.

Unpack the microscope and its parts carefully. Do not throw away any boxes or packing materials until the contents of the shipping container have been checked against the packing list sent and your order.

1-2 ASSEMBLY

The binocular or trinocular body will be stowed separately and should now be mounted on the limb and clamped, when it is squared with the base.

It is important that this be oriented correctly on the microscope limb. Make sure, therefore, that the locating pin on the bottom face of the body is properly "keyed in" to the slot milled in the inner/upper face of the microscope limb.

To mount the body, loosen the clamp screw and insert the cone fitting of the body into the recess in the top of the limb and push the cone fitting toward and against the spring stopper until the body gently slips into position.

Place the microscope and parts on a sturdy table or desk which gives firm and stable support. This should be located where the atmosphere is as clean as possible, avoiding the places where there is excessive dust, moisture, heat or fumes.

When in place insert eyepieces in the eyetubes of the binocular body and mount the objectives on the centering objective nosepiece, starting with the lowest magnification. Place this in the fixed (not centerable) opening. Then position the others to the right in order of increasing magnification. Cover with the plastic dust cover supplied until ready for adjustment and use.

IMPORTANT! Before plugging the illuminator into any electric outlet, make sure that transformers and illumination bases supplied to you are suitable to the current available. (When shipped these will be labelled as to voltage and cycles specification.)

2 OPERATING INSTRUCTIONS

2-1 OPTICAL SET-UP AND ILLUMINATION

- (i) Turn on the illuminator. Place the specimen slide you wish to examine on the microscope stage and rotate the 10X objective into position for focus.
- (ii) Move the substage condenser up to its top position, using the rack and

pinion focusing control. Check to make sure that both the field iris (in the microscope base) and the aperture iris (in the substage condenser) are fully open.

- (iii) Focus down on your specimen slide until detail can be seen. Adjust the brightness of the in-base light source, using the intensity control knob, left-hand back on the base.

BINOCULAR ADJUSTMENT

Comment Using a binocular body is much more efficient and less tiring than monocular bodies, but it must be adjusted correctly. When it is perfectly adjusted the images coming from the two eyepieces are "fused" into one better image in eyes of the observer.

After you have focused on the specimen proceed as follows:-

- a. Move the slides on which the two binocular body eyepiece tubes are mounted in and out until the distance between them is exactly the same as the distance between the pupils of the observers eyes. (This is the "interpupillary distance".)
 - b. When this is done note the dimension which is displayed in the window of the slider. Always remember to set to this distance when using the microscope. It will be different for different observers, so they will have to check the best setting for themselves.
 - c. Now use the fine focus to get a sharp image in the eyepiece without diopter adjustment collar. This eyepiece should be in the left-hand eyepiece tube and you should use your left eye.
 - d. Using the right eye, adjust the diopter adjustment collar in the eyepiece in the right-hand eyepiece tube to get the sharpest possible image. Do not use fine focus.
- (iv) Now turn the field iris adjustment ring until the field iris is seen in the field of view.
 - (v) Raise or lower the substage condenser so as to focus the field iris as sharply as possible in the plane of your specimen. When this is done open out the field iris until it is just outside the field of view.
 - (vi) Removing one of the eyepieces, observe the disc of light coming from the back of the objective in use. Close down the aperture iris, using the lever on the substage condenser, until only about 70%-80% of the disc of light observed remains visible. (Note that the microscope is now set up for use with the 10X objective. Similar adjustments to those mentioned above should be made when using any of the objectives required.)
 - (vii) Regarding the note above, if you choose the 100X objective, immersion oil must be applied to the specimen slide so that, when this objective

is swung in and focused, both the specimen slide and the 100X objective are in good, bubble-free contact.

(viii) The tension control knob is provided to allow the individual user to adjust the focus tension to his/her own preference. Tension may be increased by turning the knob with a counterclockwise motion. A lighter tension may be set by turning clockwise.

3 SPECIAL POLARIZING FACILITIES

Please note that the applications and detailed techniques of polarizing microscopy are beyond the scope of this manual. What follows is a description of the special features of the ML-POL Polarizing Microscope which are often used in geological, mineralogical, chemical and other optical studies which have long been associated with the polarizing microscope.

3-1 SUBSTAGE POLARIZER

This is fully rotatable with a swing-out, click-in mount. When the polarizer is swung out, the light is not polarized.

When it is swung into the path and clicked into its correct position, the polarizer may be rotated, sending polarized light with angles from 0-360 degrees up to the specimens. Angular settings for 0 degrees and 90 degrees are marked on the mounting so that these common settings can be located quickly and precisely.

3-2 SLIDE-IN ANALYZER

This is mounted in an in-tube slider which moves the analyzer in and out of the optical path. When "in", and with the substage polarizer also "in" and set at 0 degrees, these elements are said to be "crossed" and the field of view is said to be "extinguished". In this condition the field of view is dark - except for optically active elements in the field, which rotate the angle of polarization and thus become visible against a dark background. This is the basic advantage of a polarizing microscope.

3-3 ROTATING STAGE

A ball-bearing circular stage, precisely rotatable through a full 360 degrees, is supplied as standard. Upon rotation angular measurements can be made, reading by a vernier to 0.1 degrees.

3-4 INDIVIDUALLY CENTERING QUADRUPLE NOSEPIECE

Four objectives can be carried in the ball-bearing rotating nosepiece. The lowest magnification objective lens is mounted in the fixed threaded opening and three higher powered objectives are placed in threaded mounts which can be precisely and easily centered, so that all are exactly paracentral with each other. Centering can be carried out with the hexagon keys supplied. However, when the microscope is shipped to you the objectives are factory par-centered. Therefore, before undertaking this operation, check to make

sure that the objective has been precisely seated on the optical axis. If it is even slightly off axis the centering will appear wrong.

Note: It is important that you change magnifications by rotating the milled nosepiece ring, not by grasping and pulling the objective barrels. Doing this puts strain on the objective housings which can cause some decentering.

3-5 BERTRAND LENS

The ML-POL features an in-tube, slide-in Bertrand Lens. Fitted with it is a field-limiting aperture which allows isolation of small features in the center of the field. Thus the characteristic interference figures for small crystalline elements can be observed and studied. These effects only occur when both analyzer and polarizer are in the optical path, the polarizer being set at 0 degrees. The in-tube design of the Bertrand Lens makes it possible to use it equally well with binocular, trinocular and monocular bodies.

3-6 COMPENSATORS

A sensitive tint plate (first order red) and mica 1/4 wave plate are supplied with the ML-POL as standard. These are carried in plates with standard DIN dimensions, sliding in a slot cut in the tube just above the objective nosepiece.

3-7 CROSS-LINE EYEPIECE

A focusable cross-line eyepiece should be used in the slotted eyetube. Make sure that it is "keyed" into the slot in the eyetube, as its orientation is important and should not change. The cross-line should be sharply focused by turning the focusing ring.

4 PHOTOGRAPHY AND TELEVISION

4-1 PHOTOGRAPHY

Photographic documentation of microscope visual images is most conveniently achieved by using the trinocular (photo-binocular) bodies offered for use with MEIJI LABAX microscopes.

In the case of the ML series of biological, metallurgical and polarizing microscopes a trinocular body is supplied with a sliding switch-over beam-splitter component which either (1) allows all of the light to go to the visual eyepieces or (2) directs 80% of the image-forming light upwards to the film plane of a 35mm SLR camera, while still sending 20% of the light to the binocular eyepieces.

In this system the ML MA150/50 Camera Attachment should be used with the SLR camera model of your choice. Please note that one of the large range of T2 Adaptor Rings suiting to your camera should have been ordered and supplied.

These adaptor rings are intended to compensate for the small differences in effective distance of the film plane in your camera - so as to ensure that

photographs are optimally sharp, and achieved without wastage of film in trial shots and experimentation.

In addition special low-power camera eyepieces (2.5X and 5X) are available and recommended - these will give you maximum field coverage on your specimen while using the convenient and economical 35mm film format.

CAMERA OPERATION

- (i) Fix your 35mm SLR camera on the MA150/50 Camera Attachment, then mounting this assembly on the straight tube of the trinocular body.
- (ii) Pull out the lever on your trinocular body so as to send the image both to the camera and the visual eyepieces.
- (iii) Rotate the adjustment ring on the straight tube so as to set correctly for optimum conditions of simultaneous visual observation and photography.

TELEVISION

For television the MA 151/10 "C" Mount should be used, threaded into your TV camera, then placed and adjusted on the upper portion of your trinocular body.

Adjustment can then proceed as per paragraph (iii) above. You should understand that the comparatively large magnification factors inherent in most TV camera/monitor systems will restrict your fields of view (while blowing up total magnification).

A correct optical set-up and adjustment is, of course, crucial to obtaining a good TV monitor image, but keep in mind that the monitor controls for brightness and contrast adjustment are also important and should also be experimented with in order to obtain the best monitor image.

5 MAINTENANCE AND CARE

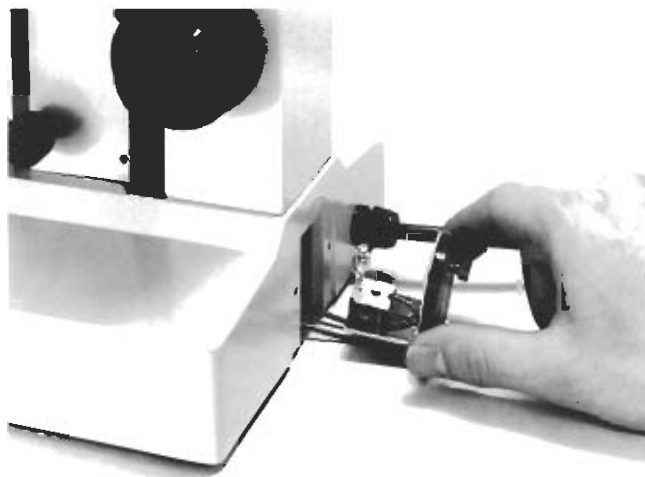
5-1 BULB REPLACEMENT

When changing light bulbs in the illuminators, always disconnect the plug from the electrical source. Never work on the electrical system without first disconnecting.

The bulb is held in a socket block inserted in the rear of the microscope base.

- (i) Remove the socket block from the microscope base by unscrewing the two screws and pulling the backing plate clear of the instrument.
- (ii) After making certain the old bulb is cool to the touch, remove it by pulling straight out of its socket. Do not twist as the lamp pins may break off and become lodged in the socket.

(iii) Handle the new bulb only with tissue paper or the plastic in which it is wrapped and insert the two pins into the two holes in the socket. DO NOT HANDLE WITH BARE FINGERS - BULB MAY EXPLODE WHEN HEATED IF NOT HANDLED CORRECTLY.



5-2 CARE

Always cover the instrument with plastic dust cover provided when the microscope is not in use.

Keep eyepieces in the microscope body at all times in order to prevent dust from falling on the internal optics.

Store the microscope in a safe, clean place when not in use for an extended period of time.

5-3 CLEANING

Clean exposed lens surfaces carefully with a pressurized air source, soft brush or clean soft cloth. Too much finger pressure may damage lens coatings.

To remove oil, fingerprints and grease smudges, moisten the cleaning cloth with a very small amount of alcohol or xylene.

Immersion oil should always be promptly cleaned from high power oil immersion objectives after every use.

Painted or plastic surfaces should be cleaned only with a cloth moistened with water and a small amount of detergent.

DO NOT ATTEMPT TO MAKE ADJUSTMENTS TO THE INTERNAL OPTICS OR MECHANICS!!

If the microscope does not seem to be functioning properly or you have questions about its operation, call your supplier (or an authorized repair service) for advice.

THE MEIJI TECHNICO ASBESTOS MICROSCOPE is a combination polarized light and phase contrast microscope. Polarized light for asbestos fiber identification, and phase contrast for fiber counting.

Normal operation under polarized light is covered in the instructions in the previous pages.

PHASE CONTRAST OPERATION.

1. The analyser and polarizer should be removed from the light path.
2. Rotate the 40XR phase contrast objective into position, and ensure that the aperture iris (on the condenser) and the field iris (on the illuminator) are fully open.
3. Focus on the specimen.
4. Push the phase annulus on slider (in substage condenser) into the light path.
5. Check that the phase rings are correctly aligned by using the focusable centering telescope in place of the eyepiece containing the Wallis-Beckett graticule. If the bright ring (condenser annulus) is not fully superimposed on the dark ring (objective annulus), adjust by using the knurled condenser centering screws.
6. Remove the centering telescope and replace the eyepiece with the W-B graticule, ensuring that the graticule is in sharp focus.
7. Adjust the irises to remove any glare or stray light.

ASBESTOS I.D. BY PLM (POLARIZED LIGHT MICROSCOPY)
FOR BULK FIBER IDENTIFICATION

METHODOLOGY FOR PLM ANALYSIS: NIOSH 9002

THIS METHOD IS USEFUL FOR THE QUALITATIVE IDENTIFICATION OF ASBESTOS AND THE SEMI-QUANTATIVE DETERMINATION OF ASBESTOS IN BULK SAMPLES. THIS METHOD MEASURES THE PERCENTAGE OF ASBESTOS AS PERCEIVED BY THE ANALYST IN COMPARISON TO STANDARD PROJECTIONS, PHOTOGRAPHS OR EXPERIENCE. THE QUALITY OF THE RESULTS ARE DEPENDENT UPON THE SKILL AND JUDGEMENT OF THE OPERATOR.

REQUIRED MICROSCOPE EQUIPMENT:

POLARIZED LIGHT MICROSCOPE 100 X-400 X WITH 10 X DISPERSION STAINING (CENTRAL STOP) OBJECTIVE

STEREO MICROSCOPE 10 X - 45 X

ASBESTOS FIBER COUNTING BY PCM (PHASE CONTRAST MICROSCOPY)

METHODOLOGY FOR PCM ANALYSIS: NIOSH 7400 & OSHA ID 160

PHASE CONTRAST MICROSCOPY IS THE METHOD THAT IS PRIMARILY USED FOR ESTIMATING ASBESTOS CONCENTRATIONS OF AIRBORNE FIBERS. THIS METHOD IS QUICK AND CAN BE PERFORMED ON-SITE FOR A RAPID DETERMINATION OF CONCENTRATIONS OF ASBESTOS FIBERS IN THE AIR. PHASE CONTRAST

MICROSCOPY DOES NOT POSITIVELY DIFFERENTIATE BETWEEN ASBESTOS AND OTHER FIBERS. POSITIVE IDENTIFICATION OF ASBESTOS FIBER MUST BE PERFORMED USING PLM OR ELECTRON MICROSCOPY (METHOD 7402)

REQUIRED MICROSCOPE EQUIPMENT:

POSITIVE PHASE CONTRAST MICROSCOPE WITH 10X BRIGHTFIELD AND 40X PHASE OBJECTIVE, GIF (GREEN INTERFERENCE FILTER), WALTON & BECKETT RETICLE TYPE-22G , AND STAGE MICROMETER WITH 0.01MM DIVISIONS .

REQUIRED TEST SLIDE: THE HSE/NPL MARK II PHASE SHIFT TEST SLIDE CHECKS OR STANDARDIZES THE VISUAL DETECTION LIMITS OF THE PHASE CONTRAST MICROSCOPE. THE HSE/NPL TEST SLIDE CONSISTS OF A CONVENTIONAL GLASS MICROSCOPE SLIDE WITH SEVEN SETS OF PARALLEL LINE PAIRS OF DECREASING WIDTHS. THE MICROSCOPE MUST CLEARLY RESOLVE LINE PAIRS 1-3. LINE PAIRS 4-5 MUST BE AT LEAST PARTIALLY VISIBLE. LINE PAIRS 6-7 MUST BE INVISIBLE. A MICROSCOPE WHICH FAIL TO MEET THESE REQUIREMENTS IS EITHER TOO LOW OR HIGH IN RESOLUTION AND CANNOT BE USED FOR ASBESTOS IDENTIFICATION.

Asbestos Fiber Counting by Phase Contrast Microscopy

Methodology for PCM Analysis: NIOSH 7400 & OSHA ID160

Phase contrast microscopy is the method that is primarily used for estimating asbestos concentrations of airborne fibers. This method is quick and can be performed on-site for a rapid

determination of concentrations of asbestos fibers in the air. Phase contrast microscopy does not positively differentiate between asbestos and other fibers. Positive identification of asbestos fiber must be performed using PLM (Polarized Light Microscopy) or Electron Microscopy (Method 7402)

Required Microscope Equipment

Positive phase contrast microscope with 10X Brightfield and 40X Phase objectives, GIF (Green Interference Filter), Walton & Beckett reticle Type-22G and a stage micrometer with 0.01mm divisions.

Required Test Slide

The HSE/NPL Mark II Phase Shift Test Slide checks or standardizes the visual detection limits of the phase contrast microscope. The HSE/NPL Test Slide consists of a conventional glass microscope slide with seven sets of parallel line pairs of decreasing widths. The microscope must clearly resolve line pairs 1 thru 3. Line pairs 4 and 5 must be at least partially visible. Line pairs 6 and 7 must be invisible. A microscope which fails to meet these requirements is either too low or too high in resolution and cannot be used for asbestos detection.

BASIC POLARIZED LIGHT MICROSCOPY TERMINOLOGY

COMPENSATORS & RETARDATION PLATES

Polarized Light microscopy is a useful tool for distinguishing between singly refracting (optically isotropic) and doubly refracting (optically anisotropic) material. Quantitative measurements of optical anisotropy is used in the optical analysis of doubly refracting or birefringent materials under polarized light. These measurements are made with the aid of accessory plates called compensators and retardation plates. Retardation plates have a fixed optical path difference and compensators have a variable optical path difference. The intermediate tube of the Meiji polarized light microscope houses either sliding or rotatable analyzer, a sliding Bertrand lens and a slot for insertion of retardation plates and compensators. The dimensions of the compensator/retardation plate are DIN standard 20mm X 6mm.

QUARTER WAVE-PLATE - The quarter wave length retardation plate is a thin slice of birefringent material (e.g. mica) cut to a thickness to give $1/4$ optical path difference (OPD) in yellow light of about 145nm. The quarter wave-plate changes linear or plane polarized light into circularly polarized light. The quarter wave-plate is useful for qualitative analysis of orthoscopic and conoscopic images. The quarter wave plate is also used for assessment of optical path differences in birefringent specimens. $1/4$ plate 145nm

FIRST ORDER RED PLATE - The first order retardation plate is a thin slice of birefringent material (e.g. gypsum) cut to a thickness to give 1 optical path difference (OPD) for green light. The first order red plate is frequently used to determine the optical sign (positive or negative) of a birefringent specimen and is also utilized for contrast enhancement in weakly birefringent specimens. The first order red plate produces an interference color having a typical tint of the first order red. The first order red plate is known by several names, including: gypsum plate, lambda plate, sensitive tint plate, and full wave plate. 1 plate = 550nm

QUARTZ WEDGE - The quartz wedge is a variable compensator which is designed to produce a range of retardation values as the wedge is moved in and out of the optical path. The thin edge of the wedge produces an optical path difference of zero. The optical path difference increases with increasing thickness of the wedge. Each separate wavelength in the spectrum produces a series of dark extinction bands of which the OPD is exactly one wavelength apart. Specimen retardation values can be determined by observing changes in the polarization properties of birefringent specimens as the wedge thickness in the light path varies. Meiji's quartz wedge permits retardation measurements from 1-6 wavelengths.

SENARMONT COMPENSATOR - The Senarmont compensator is useful tool for measurement of retardation levels of crystals, living organisms and also for measuring permanent stresses in clear materials. The Senarmont compensator is also used for image contrast enhancement of weakly birefringent specimens.

ANALYZER - A polar plate in the light path after the specimen. The analyzer is removable from the light path and may be rotatable. The analyzer is used to determine the optical effects produced by the specimen either in plane or polarized light.

BERTRAND LENS - The Bertrand lens is located above the analyzer. The eyepiece and Bertrand lens act as a system to focus on the back image plane of the objective. The Bertrand lens main function is to view interference figures (conoscopic images) which appear in the back image plane of the objective when the specimen is viewed between crossed polars using highly convergent light from the condenser.

BIREFRINGENCE - A quantitative expression of the separation of a light beam as it penetrates a doubly refracting object into two diverging beams.

CONOSCOPIC FIGURE - A pattern consisting of isogyres and/or isochromatic curves formed in the back image plane of the objective also referred to as an interference figure.

CONOSCOPIC OBSERVATION - Observation of the conoscopic or interference figure by means of a Bertrand lens.

PLANE-POLARIZED LIGHT - Light with only one vibration direction present.

PLEOCHROISM - A property exhibited by certain crystals of absorbing selectively various wavelengths of light and of displaying different colors when looked at in the directions of their various crystal axes.

POLAR - A device which produces plane polarized light from natural light.

POLARIZER - A polar placed in the light path before the specimen.

STRAIN FREE - A term used to signify that microscope objectives and condenser lenses are selected to have a minimum amount of internal stress in the glass. Strain free optics offers little or no contribution to the optical path difference of the specimen.