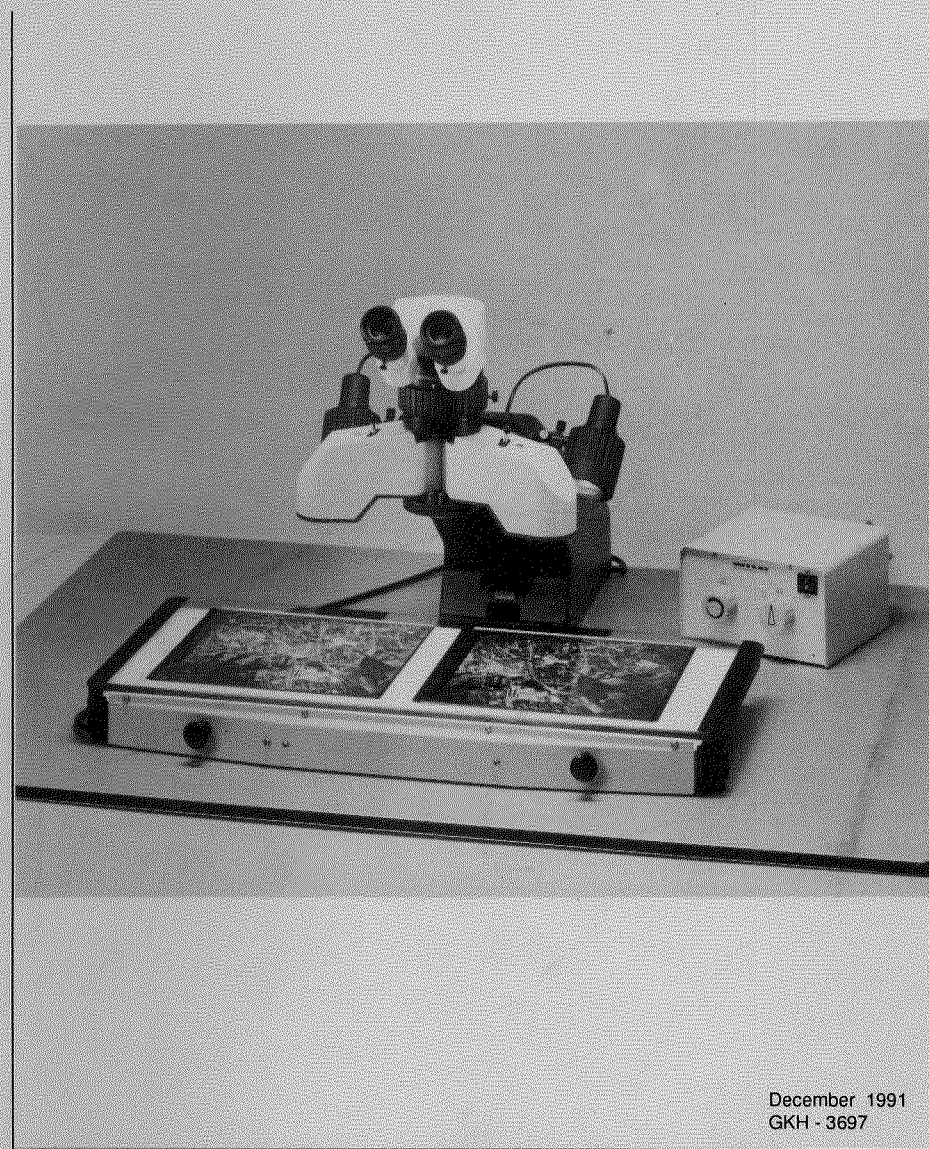


WILD APT 2

Stereo Photointerpretation System



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1 INTRODUCTION

1.1 YOUR PHOTOINTERPRETATION SYSTEM

Your APT2 Stereo Photointerpretation System helps you to evaluate terrestrial, aerial and satellite photography (SPOT 24 cm x 24 cm) most efficiently and conveniently.

The optics provide a sharp, chromatically correct image, free from distortion right out to the edges, with high resolution and a 1:5 zoom range. They give you a good overall view of the area to be interpreted with a maximum field of view of 71 mm in diameter (at 3.1x magnification), whilst details can be examined by zooming up to 15.5x magnification.

A full range of optional accessories lets you expand the system's capabilities:

- For greater total magnification » use 15x or 20x eyepieces.
- To view transparencies such as original negatives or color and false-color diapositives » use the adjustable transmitted-light unit.
- For measuring X-parallax from which height differences can be calculated » use the stereomicrometer, also called parallax bar.
- For determining distances, slope angles and areas » use a set of scale and grid graticules in one of your eyepieces.
- For training and interdisciplinary discussions » use the discussion tube so that a second observer can see exactly the same image.
- To project the image of a map or an interpretation key into the right eyepiece » use the drawing tube with mirror.
- To produce high quality, enlarged, photographic excerpts for field identification, documentation or as an interpretation key » use the photographic system.
- To show a section of a photograph on a high resolution video monitor » use the video system.

1.2 YOUR OPERATOR MANUAL

This manual gives you all the information required for assembling, operating and maintaining your APT2 Stereo Photointerpretation System. It is divided into two volumes.

Volume I: Lists and describes the entire APT2 system, from basic equipment to optional accessories. It shows you how to install and use all items except the photographic system.

Volume II: Explains the Photographic System. Volume II is supplied only if you have purchased this option for the APT2.



Illustrations are numbered in order, starting with figure 1 in each volume. Reference to the illustrations is made in the text by a bracketed two-part number separated by a slash. The first number is the figure number, the second refers to the item in the respective illustration. Example: (8/1) refers to Fig. 8, item 1.

Instructions which are particularly important in terms of functional reliability and safety are highlighted under the headings "WARNING", "CAUTION," and "NOTE".

WARNING

Highlights procedures where strict compliance is required in the interest of personnel safety.

CAUTION

Highlights procedures which have to be strictly followed in order to avoid damage to the equipment.

NOTE

Marks instructions and explanations to which special attention must be paid in a particular procedure.

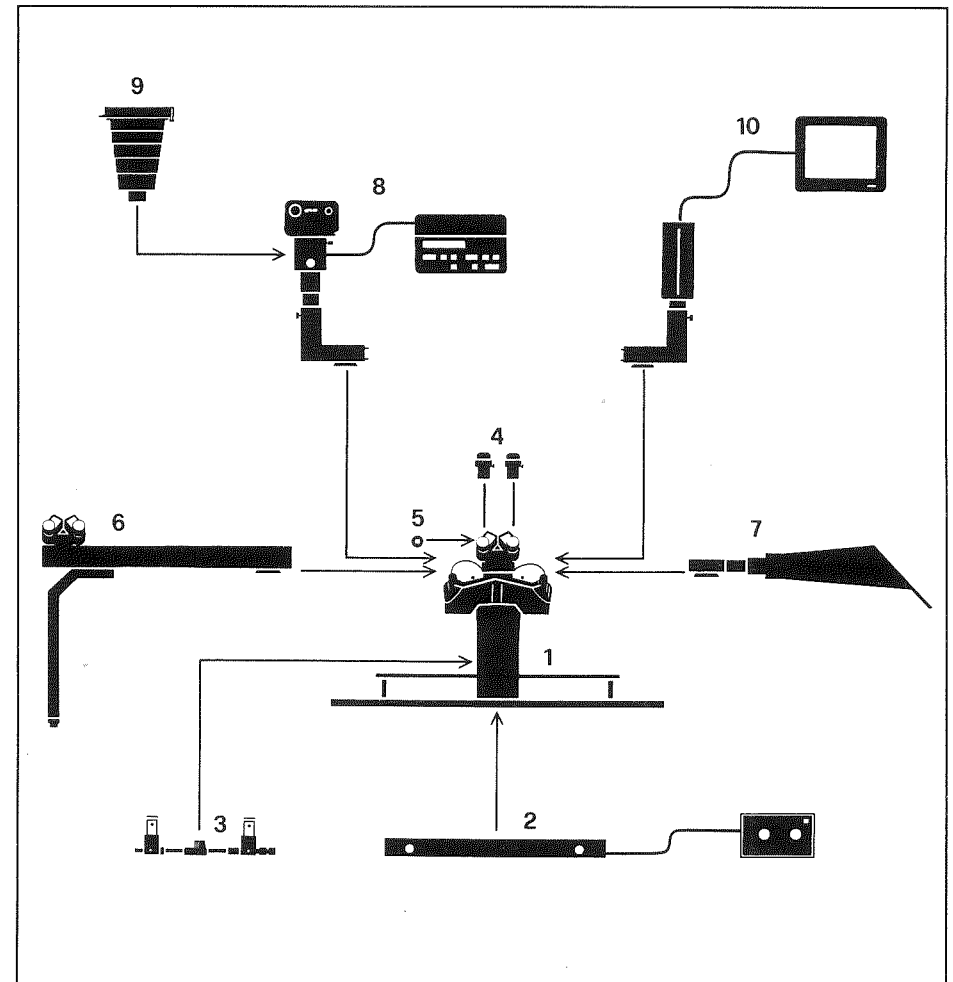
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APT2 System Configuration

Fig. 1



- | | |
|--------------------------|-----------------------|
| 1 Basic equipment | 6 Discussion tube |
| 2 Transmitted-light unit | 7 Drawing tube |
| 3 Stereomicrometer | 8 Photographic system |
| 4 Special eyepieces | 9 Polaroid option |
| 5 Eyepiece graticules | 10 Video system |

2 DESIGNATION OF EQUIPMENT**2.1 BASIC EQUIPMENT****560 199 APT2 Stereo Photointerpretation System, consisting of:**

- 392 823 1 Optics carrier, basic APT2 viewer unit
- 429 781 1 Inclined binocular tube
- 445 111 2 Eyepieces 10 x /21B, adjustable, with eyecups
- 479 872 1 Stereoscope carrier with parallel-guided picture carriage, worktop and incident lighting, incl. tools, 2 spare bulbs, 10 suction cups
- 392 822 1 Standard accessories for APT2, consisting of dust cover, lens tissue, spanner, adjustment pin
- 210 778 1 Pencil holder

2.2 ADDITIONAL EQUIPMENT**2.2.1 Transmitted lighting for viewing transparencies****527 333 Transmitted-light unit, adjustable, consisting of:**

- 479 873 1 Transmitted lighting with 2 spare discharge lamps
- 479 875 1 Control unit (transformer)

2.2.2 Stereomicrometer for parallax measurement**527 334 Stereomicrometer, complete, consisting of:**

- 333 973 1 Stereomicrometer holder
- 200 730 1 Stereomicrometer
- 167 306 1 Case for stereomicrometer

2.2.3 Special eyepieces

Suitable for inclined binocular tube and discussion tube. To be used in pairs.

- 445 301 Eyepiece 16x /14B, adjustable, with eyecup
- 445 302 Eyepiece 20x /9.5B, adjustable, with eyecup

2.2.4 Eyepiece graticules for measuring and counting**429 849 Set of graticules, in case, consisting of:**

- 376 119 1 Graticule with 12 mm scale and crosshairs
- 394 771 1 Graticule with 5 mm scale
- 376 122 1 Graticule with 100 x 1 mm² grid
- 376 121 1 Graticule with 400 x 0.25 mm² grid
- 427 572 1 Stage micrometer for APT2

2.2.5 Discussion tube for dual observation**560 200 Discussion tube, consisting of:**

- 479 887 1 Discussion tube for APT2
- 533 142 1 Support for discussion tube
- 429 781 1 Inclined binocular tube
- 445 111 2 Eyepieces 10x /21B, adjustable, with eyecups
- 401 823 1 Dust cover, for APT2 and discussion tube

2.2.6 Drawing tube for map revision and comparison

- 479 876 Drawing tube with mirror

2.2.7 Photographic system**563 749 Photoautomat with 35 mm camera and lighting, consisting of:**

- 404 891 1 Phototube with built-in double iris diaphragm (observation 100% /0%; camera 0% /100%)
- 445 546 1 Eyepiece tube, diameter 40 mm
- 445 304 1 Eyepiece 10x /21, fixed
- 445 075 1 Shutterpiece for integrated and spot metering
- 280 636 1 Mains cable, 2 m
- 445 603 1 Photoautomat with dust cover
- 445 110 1 35 mm magazine with motorized film transport
- 445 541 1 Camera objective 0.32 x
- 445 158 1 Filter slide housing for 2 filters
Polaroid option for photoautomat 563 749
- 479 874 1 Photolight with filter set
- 368 051 1 Focusing telescope for shutterpiece

473 753 Camera back with 3^{1/4}" x 4^{1/4}" Polaroid magazine, consisting of:

- 419 612 1 0.8 x magazine holder with magazine for 3^{1/4}" x 4^{1/4}" Polaroid film pack
- 419 610 1 Adapter for objective 0.8 x
- 195 182 1 Camera objective 0.8 x

2.2.8 Video system

Note For the video systems below you also need the following items from the photographic system: 404 891, 304 490, 360 200.

479 979 Video system with 9" (22 cm) monitor, consisting of:

- 479 877 1 SONY CCD colour video camera DXC-101P
- 479 880 1 SONY mains adapter CMA-DI/CE
- 479 892 1 SONY colour monitor PVM-9020ME, 9" (22 cm)
- 346 902 1 Video connector piece (C-mount adapter)

479 980 Video system with 13" (33 cm) monitor, consisting of:

- 479 877 1 SONY CCD colour video camera DXC-101P
- 479 880 1 SONY mains adapter CMA-DI/CE
- 479 893 1 SONY colour monitor PVM-1371QM, 13" (33 cm)
- 346 902 1 Video connector piece (C-mount adapter)

3 TECHNICAL DATA

Optics

Magnification, with 10x eyepieces	3.1 x to 15.5 x (standard)
with 15x eyepieces	4.6 x to 25 x
with 20x eyepieces	6.2 x to 31 x
Diameter of field of view	71 mm at 3.1 x magnification 7.1 mm at 31 x magnification
Resolution	100 lp/mm, maximum
Dioptric range	-5 dptr to +5 dptr
Distance of exit pupil (eye relief)	
with standard eyepieces	22 mm
with eyepieces 346 922 or 346 929	12 mm
Diameter of exit pupil	2.2 mm (3 x), 1.1 mm (15 x)
Interpupillary distance (eye-base)	52 mm to 76 mm
Focusing range of objective	6 mm
Instrument base (optical separation)	229 mm to 249 mm
Adjustment range for vertical parallax	± 38 mm

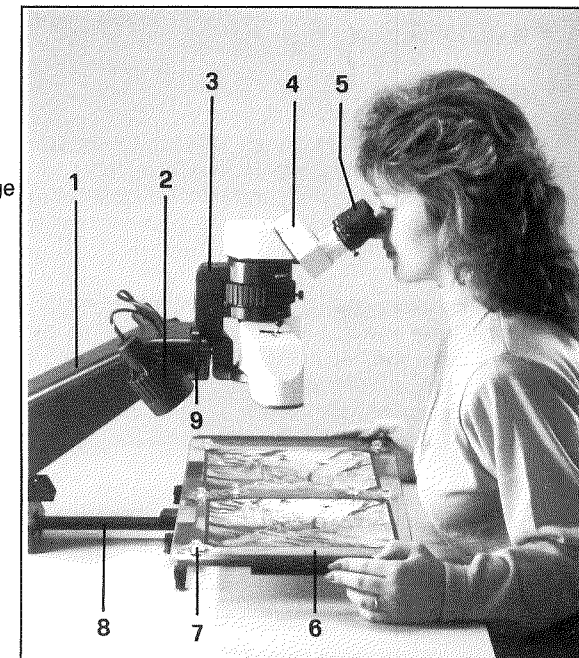
Dimensions and weight

Picture carriage	670 mm x 295 mm
Range of X motion	180 mm
Range of Y motion	238 mm
Minimum table area required	850 mm x 850 mm
with discussion tube	965 mm x 850 mm
Minimum clearance at rear of table	240 mm
Overall height above table	446 mm
Weight, basic equipment	34 kg
with discussion tube	39 kg
Pencil holder	
Diameter of plotting-tool insert	8.8 mm
Clearance from plotting tip to plotting surface	5 mm (plotting tool raised)
Holder for stereomicrometer	
Y-parallax screw adjustment range	
at 125 mm from centre of instrument	±15 mm
Electrical data, transmitted lighting	
Mains supply	100 V, 115 V, 125 V, 200 V, 220 V, 235 V, 250 V (all ±10%)
Power consumption	60 VA

APT2 Basic Equipment

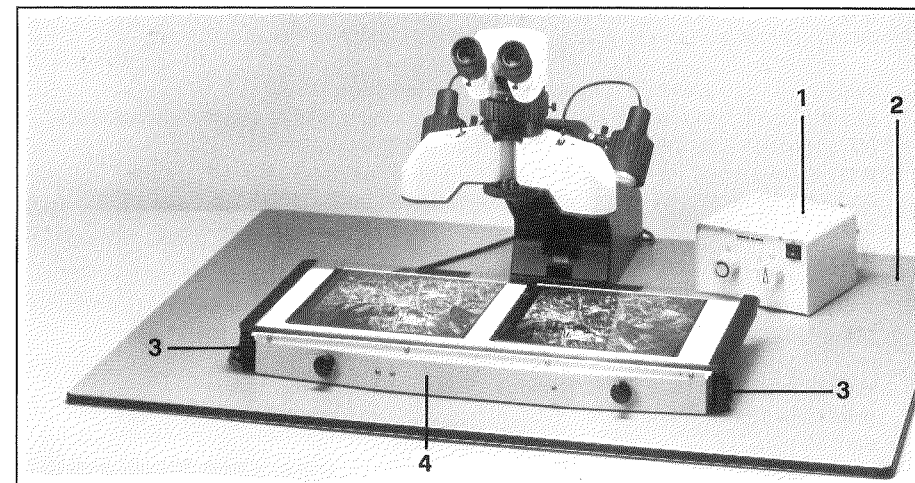
Fig. 2

- 1 Stereoscope carrier
- 2 Incident lighting
- 3 Inclined binocular tube
- 4 Eyepieces
- 5 Optics carrier
- 6 Parallel-guided picture carriage
- 7 X-guide rail
- 8 Y-guide rail
- 9 Suction cups
- 10 Slot for optics carrier



APT2 with Transmitted-light unit

Fig. 3



- 1 Control unit (transformer)
- 2 Aluminium coated worktop
- 3 Carriage blocking levers
- 4 Transmitted lighting

4 TECHNICAL DESCRIPTION

4.1 BASIC EQUIPMENT

4.1.1 General

The APT2 is a zoom stereoscope for viewing pairs of stereophotographs. You can place photographic material up to 24 cm x 24 cm in size on the picture carriage (2/6) and illuminate it either from above by incident light (2/2), or from below by transmitted light (3/1 and 3/4, optional).

The aluminium coated worktop (3/2) of the APT2 should be placed on a rigid table having a flat surface of at least 85 cm x 85 cm. A clearance of 24 cm is required at the rear for the projecting Y-guide rail (2/8). The picture carriage moves in a parallel-guidance system, permitting you to move through the whole stereomodel without having to shift or rotate the photographs.

The slot (2/9) in the upper portion of the stereoscope carrier (2/1) bears the optics carrier (2/3). Note that you can also fit a WILD ST4 mirror stereoscope instead.

4.1.2 Parallel-guided picture carriage

The height reference plane for the picture carriage is the worktop. The parallel-guidance system comprises the Y-guide rail (2/8) for the primary motion, and the X-guide rail (13/3) for the secondary motion. When the small levers (3/3) are in the down position (4/5) you can grasp the sleeves of the two pivot-roller mounts (4/6) and move the picture carriage. In the up position the carriage motion is blocked.

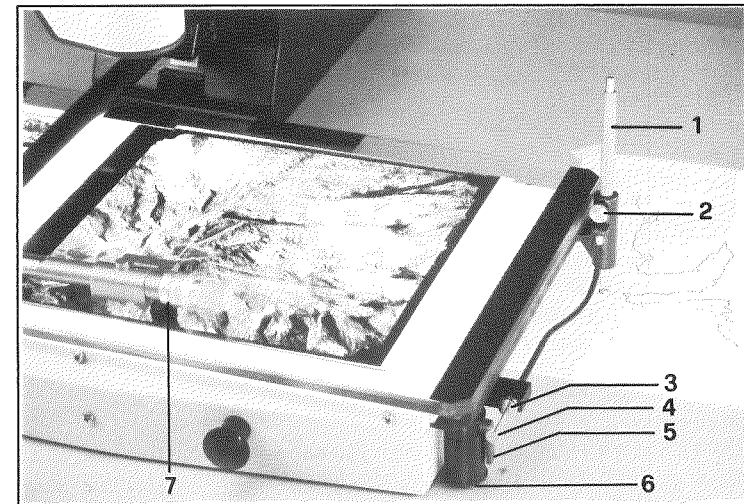
With the pencil holder (4/1) fitted to the right-hand rear corner of the picture carriage you can guide the measuring marks of the stereomicrometer (4/7, option) along the outlines of objects or along the terrain at a given height and thus plot a simple map with planimetric details and form lines. Inserts up to 8.8 mm diameter can be placed in the pencil holder. The insert is raised and lowered by means of the cable release (4/4). Two operating methods are possible:

With the stop ring (4/3) screwed home, the insert is raised when the cable release is pressed, and lowered when the cable release is released.

With the stop ring (4/3) freed, the insert is lowered when the cable release is pressed, and raised when the cable release is pressed a second time.

Picture Carriage with Pencil holder

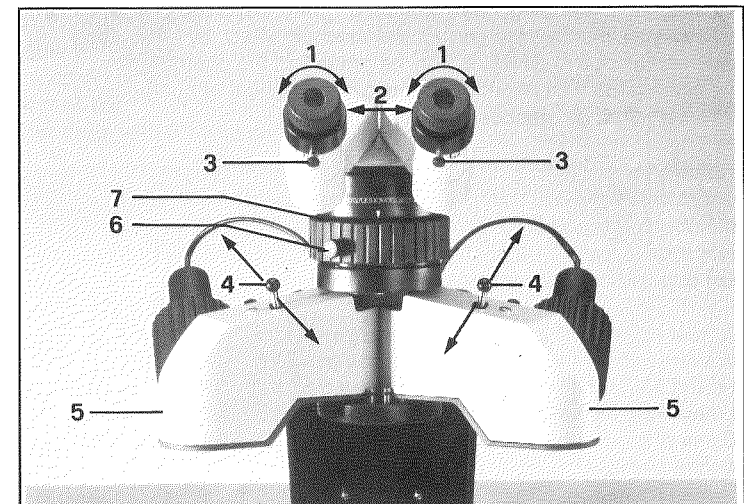
Fig. 4



- | | |
|--|---|
| 1 Plotting tool, inserted in pencil holder | 5 Carriage blocking lever (down = free) |
| 2 Clamping screw | 6 Pivot roller mount |
| 3 Stop ring | 7 Stereomicrometer |
| 4 Cable release | |

Optics

Fig. 5



- | | |
|-----------------------------------|--|
| 1 Eyelens mounts, dioptic setting | 5 Viewing arms |
| 2 Eye-base setting | 6 Zoom clamping screw |
| 3 Eyepiece clamping screws | 7 Scale (total magnification with 10x eyepieces) |
| 4 Focusing levers | |

4.1.3 Optics

The viewing optics of the APT2 comprise a pair of eyepieces (2/5), the inclined binocular tube (2/4), and the optics carrier (2/3) with the viewing arms (5/5).

Eyepieces

The standard magnification of the eyepieces is 10 x, but you can use optional eyepieces with 15 x and 20 x magnification instead. All are adjustable which means that by turning the eyelens mount (5/1) you can focus them individually for dioptric settings from -5 to +5.

Inclined binocular tube

The separation between the eyepiece tubes may be varied to suit your eye-base (5/2).

Optics carrier

The APT2 has a 1 : 5 zoom range which you can set for both pictures jointly. Scale (5/7) shows you the magnification being used and clamping screw (5/6) locks this setting.

On the upper surface of the left and right viewing arms there are levers (5/4), by which the lens system is focused according to the thickness of the photographic material, used with or without cover glass.

The viewing arms can be pivoted in and out, either separately or jointly. This allows you to obtain the correct stereoscopic effect, by eliminating vertical parallax due to tilt which may be present in the photographs, and by altering the instrument base (optical separation) to compensate for extreme height differences in the terrain.

Magnification

The zoom optics provide continuously variable magnification and thus a continuously variable field of view. With standard eyepieces total magnification is from 3.1 x to 15.5 x. For this magnification range, the exit-pupil diameter varies between 2.2 mm and 1.1 mm.

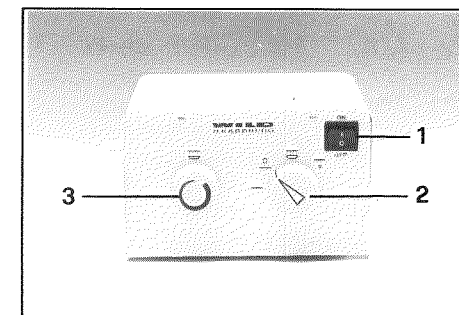
The lowest magnification gives you the largest field of view, useful for an overall view over as large an area as possible. The field of view in the APT2 has a diameter of 212 mm divided by the total magnification, i.e. a maximum field of 71 mm at 3.1 x magnification. With 230 mm x 230 mm photographs and 60% overlap, you will be able to see 12% of the total stereomodel at a glance.

A high magnification enables you to recognize the smallest details in a photograph and to eliminate the inconvenience of optical (vertical) parallax. By replacement of the 10 x standard eyepieces with eyepieces of higher power, total magnification can be increased up to 31x.

Control unit for Transmitted lighting

Fig. 6

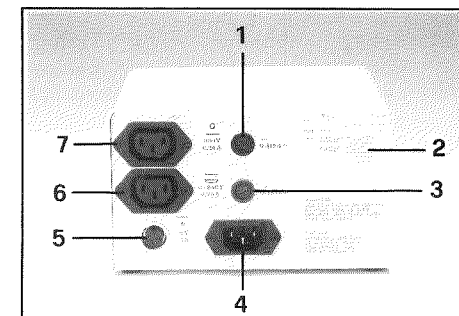
- 1 Main switch
- 2 Selector
- 3 Brightness control



Control unit, Rear view

Fig. 7

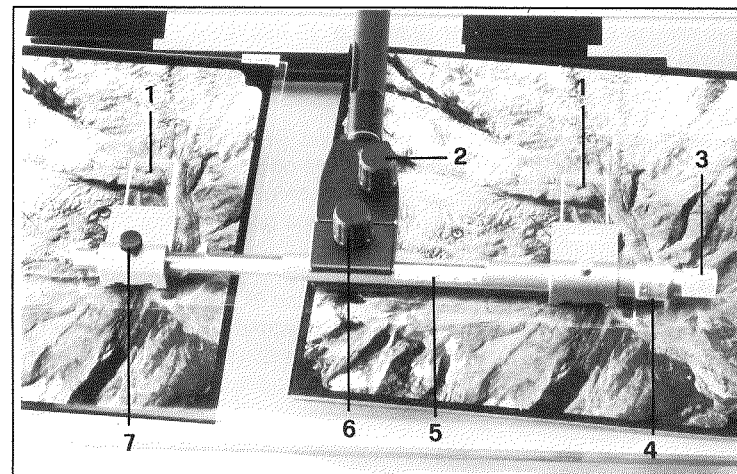
- 1 Fuse for outlet (7/7)
- 2 Set mains voltage
- 3 Fuse for outlet (7/6)
- 4 Socket for mains cable
- 5 Outlet for photolight
- 6 Outlet for transmitted lighting
- 7 Outlet for incident lighting



Stereomicrometer

Fig. 8

- 1 Glass plates with measuring marks
- 2 Y-parallax screw of stereomicrometer holder
- 3 Micrometer screw
- 4 Micrometer drum with 0.1 mm divisions
- 5 Millimeter scale
- 6 Clamp of stereomicrometer holder
- 7 Clamping screw for approximate setting



4.2 ADDITIONAL EQUIPMENT

4.2.1 Transmitted lighting

This slide-in unit (3/4) illuminates the picture carriage from below. It contains two 18 W fluorescent lamps. You can regulate its brightness with knob (6/3) when you connect it to socket (7/6) on the control unit (transformer). Alternatively, though without the possibility to regulate brightness, you may use socket (7/7) or plug into a 220 V ($\pm 10\%$) mains outlet.

If you wish to regulate the brightness of the incident lighting you can branch it to socket (7/6).

4.2.2 Stereomicrometer

Also known as parallax bar, the stereomicrometer (Fig. 8) allows you to measure parallax differences of individual image points in a stereopair and compute their height differences. You will also use the stereomicrometer together with the pencil holder if you want to trace objects or form lines.

Three different shapes of marks (circle, dot, cross) are etched on the measuring mark glass plates (8/1). When inserted in the stereomicrometer, the right mark is fixed and the left is movable. Screw (8/7) clamps the left mark for coarse adjustment, while micrometer screw (8/3) changes the distance between the marks by exactly the amount shown on the micrometer drum (8/4).

To keep the stereomicrometer in its correct position, it is clamped to the head of the holder (8/6) which protracts from the stereoscope carrier. To eliminate y parallax, the stereomicrometer can be pivoted horizontally by means of the y-parallax screw (8/2).

4.2.3 Special eyepieces

Listed in para. 2.2.3 you will find optional eyepieces with higher magnification. Those with eyecups are designed for spectacle wearers and have an eye relief of 22 mm instead of 12 mm, i.e. 10 mm more space between exit pupil and lens.

4.2.4 Eyepiece graticules

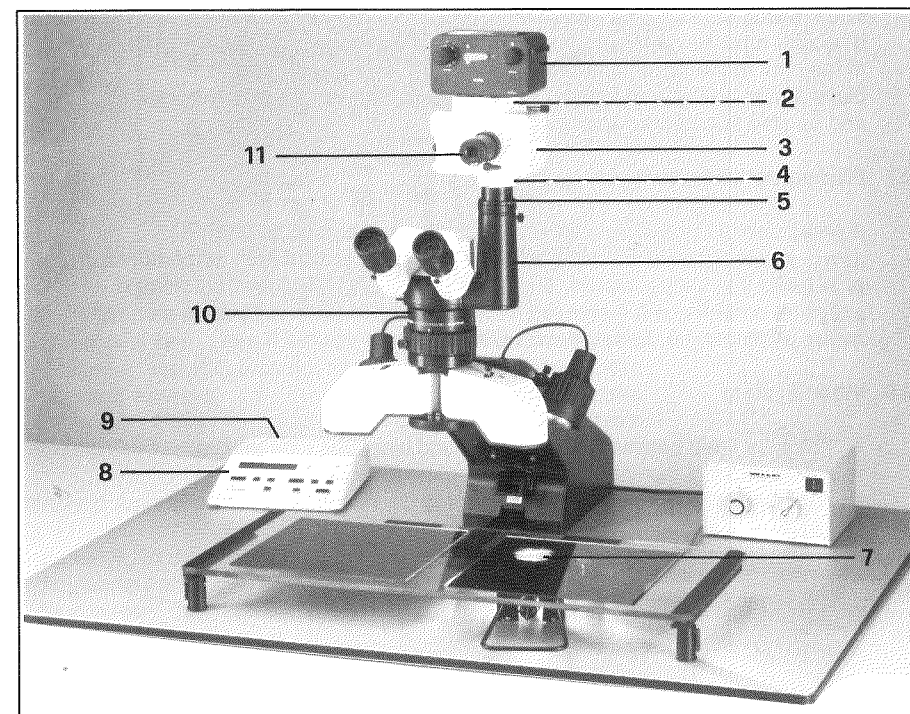
For measuring and counting there are different graticules, i.e. glass discs with scale or grid patterns which you can insert into one of the eyepieces. When calibrated by means of the stage micrometer you can use them to determine tree crown diameters, length of fault lines, slope angles, areas etc.

4.2.5 Discussion tube

The discussion tube (Fig. 28) fits between optics carrier and inclined binocular tube. It presents an identical stereomodel to a second person. Both observers can have their own eye-base and dioptric settings. A movable light pointer enables them to refer to a particular detail in the stereomodel.

Photographic System

Fig. 9



- 1 35 mm magazine
- 2 Camera objective 0.32 x
- 3 Shutterpiece
- 4 Eyepiece 10 x / 21, fixed
- 5 Eyepiece tube
- 6 Phototube
- 7 Photolight
- 8 Photoautomat
- 9 Mains cable
- 10 Filter slide housing
- 11 Focusing telescope

4.2.6 Drawing tube with mirror

The drawing tube (Fig. 32) fits between optics carrier and inclined binocular tube. Its mirror projects an image of the worktop surface to the right of the picture carriage into the right eyepiece. If you place a map on the worktop you will see it together with the stereomodel and be able to compare and revise it.

4.2.7 Photographic system

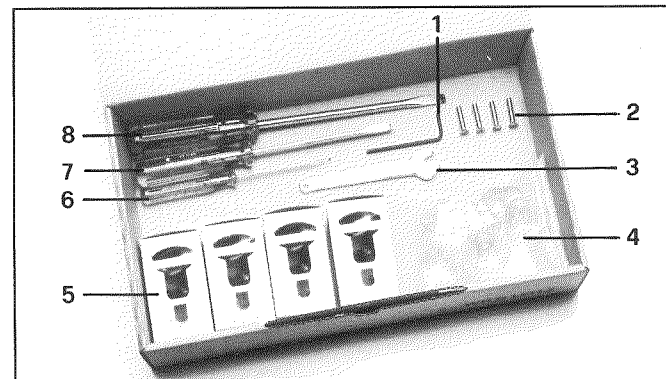
A phototube (9/6) fitted between optics carrier and binocular tube allows you to utilize all of the light in the left or right optical path for photography, or to direct it to the eyepieces. The photoautomat (9/8) features automatic exposure control and a motorized 35 mm magazine (9/1). A polaroid magazine is also available. For further details please refer to volume II.

4.2.8 Video system

A phototube fitted between optics carrier and binocular tube allows you to utilize all of the light in the left or right optical path for recording on a colour video camera, or to direct it to the eyepieces. The system is available with a 9" or 13" colour monitor.

Accessories for 479 872 Stereoscope Carrier

Fig. 10

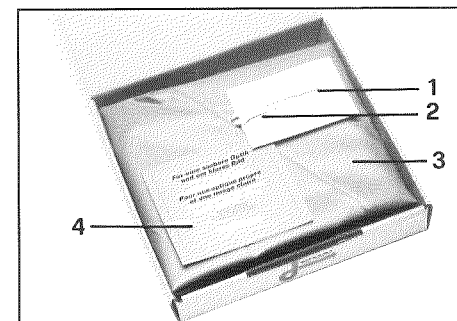


- | | |
|---|--|
| 1 Hexagonal key, .. mm | 5 Reflector lamp blubs, 25W /220V (4 pieces) |
| 2 Screws (stereoscope carrier to worktop, 4 pieces) | 6 Screwdriver 1 mm |
| 3 Spanner, 10 mm | 7 Screwdriver 3 mm |
| 4 Suction cups (10 pieces) | 8 Screwdriver 5 mm |

Standard Accessories

Fig. 11

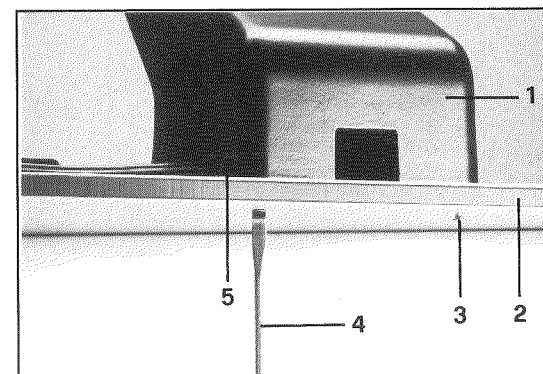
- 1 Spanner, 7 mm
- 2 Adjustment pin
- 3 Dust cover
- 4 Lens tissue



Secure Stereoscope Carrier to Worktop

Fig. 12

- 1 Stereoscope carrier
- 2 Worktop
- 3 Screws (4 pieces)
- 4 Screwdriver, 5 mm
- 5 Slot for cable



5 INSTALLATION

5.1 BASIC EQUIPMENT

5.1.1 General

Dust and dirt degrade the image quality in any optical instrument. The cleaner the instrument room, the less time and effort is required to maintain your APT2 in good condition.

It is important to have a suitable table for setting up the photointerpretation system. It should be stable and of sufficient size (see chapter 3 for dimensions), providing adequate room on both sides for paper and drawing materials. Its surface must be flat and level.

Figures 10 and 11 show the tools and accessories supplied with the APT2 basic equipment.

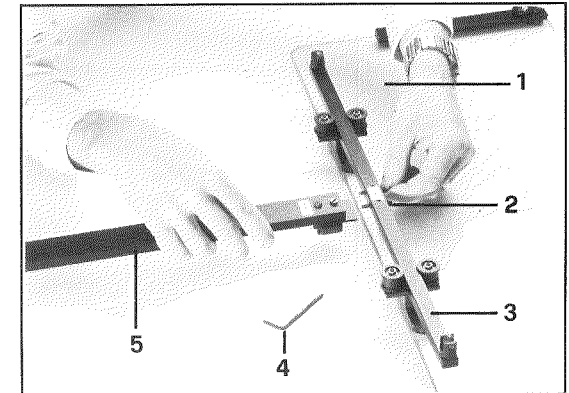
5.1.2 Assembly of stereoscope carrier

- 1) Place aluminium coated worktop (12/2) on a suitable table, its four holes just outside the edge of the table.
- 2) Place stereoscope carrier (12/1) on worktop. Make sure that the cable passes through slot (12/5). Secure carrier from below by four screws (12/3). Shift worktop to its final position.

Attaching Y-Guide Rail

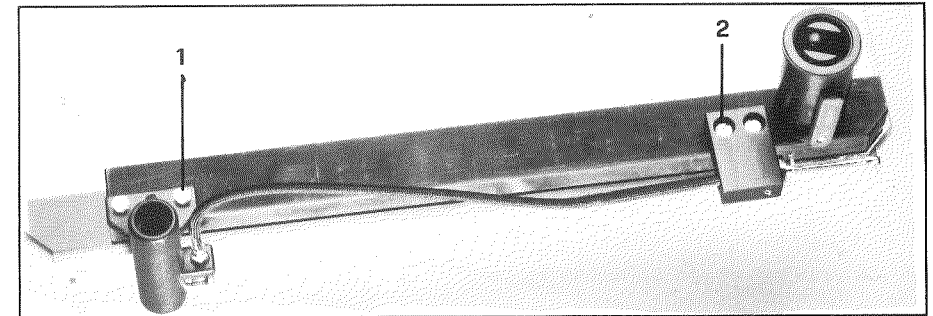
Fig. 13

- 1 Parallel-guided carriage
- 2 Allen screw (2 pieces)
- 3 X-guide rail
- 4 Hexagonal key
- 5 Y-guide rail



Picture Carriage, Upside Down on Table

Fig. 14

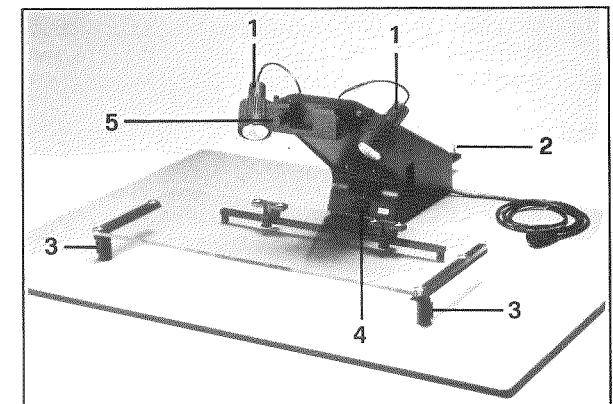


- 1 Screw for pencil holder (2 pieces)
- 2 Screw for cable release (2 pieces)

Inserting Picture Carriage

Fig. 15

- 1 Incident lighting
- 2 Rubber stop
- 3 Carriage blocking levers
- 4 Y-guide rollers
- 5 Clamp for optics carrier



5.1.3 Assembly of parallel-guided picture carriage

- 1) Unscrew rubber stop (15/2) and two Allen screws (13/2). Lay picture carriage upside down on table so that its right edge protrudes slightly over the side of the table.
- 2) Fit pencil holder as shown in Fig. 14.
- 3) Use hexagonal key (13/4) to attach Y-guide rail (13/5) to X-guide rail (13/3). Ensure that both rails fit neatly and that both screws are fully tightened.
- 3) Lift picture carriage, turn it upright. Lower carriage blocking levers (15/3) and slide Y-guide rail through the base of the stereoscope carrier so that it runs in the Y-guide rollers (15/4). Remove rubber bands from X-guide rollers.
- 4) Screw rubber stop (15/2) to end of Y-guide rail.

NOTE

Raise carriage blocking levers (15/3). Keep them in the up position except when you do want to move the picture carriage.

5.1.4 Assembly of optical components

NOTE: If your APT2 includes a stereomicrometer holder (333 973) fit this optional item first (see 5.2.2).

- 1) Make sure clamp (17/4) is fully open, then insert optics carrier (16/4) in slot (16/2) of stereoscope carrier. Tighten clamp.
- 2) Slacken clamping screw (16/5) and remove plastic caps from optics carrier and from binocular tube (16/1). Attach binocular tube to optics carrier: engage rear side first, then lower front side. Secure tube by means of clamping screw (16/5).
- 3) Insert eyepieces and tighten clamping screws (16/6). Fitting of incident lighting

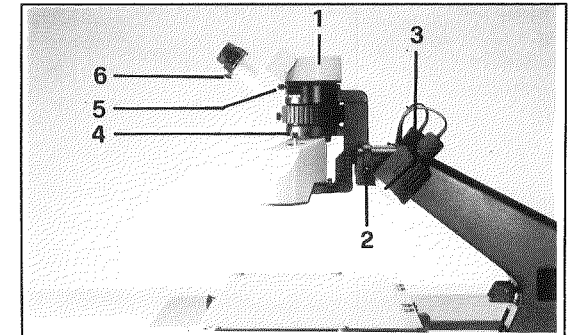
5.1.5 Incident lighting

- 1) Fit two of the 25W/220V reflector lamp bulbs (16/3) for incident lighting.
- 2) If your APT2 is equipped with the transmitted-light unit, plug cable (17/1) into control unit socket (18/4). Otherwise fit a suitable mains plug to cable (17/1), and plug cable into mains outlet.

Attaching Optics Carrier

Fig. 16

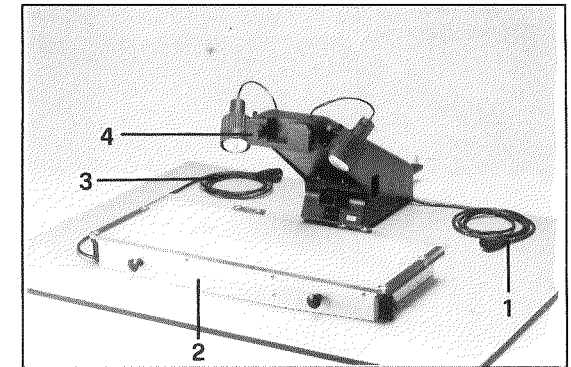
- 1 Inclined binocular tube
- 2 Slot
- 3 Reflector lamp bulb, incident lighting
- 4 Optics carrier
- 5 Clamping screw
- 6 Eyepiece clamping screw



Transmitted lighting

Fig. 17

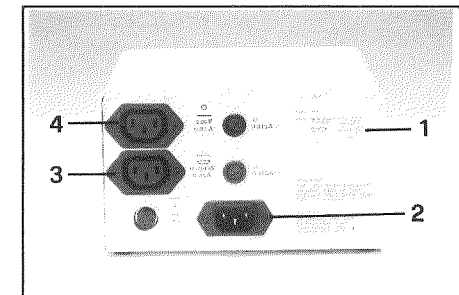
- 1 Cable for incident lighting
- 2 Transmitted lighting
- 3 Cable for transmitted lighting
- 4 Clamp for optics carrier



Control Unit, Connectors

Fig. 18

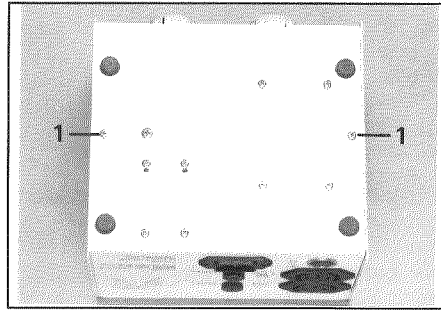
- 1 Set mains voltage
- 2 Socket for mains cable
- 3 Socket for transmitted lighting
- 4 Socket for incident lighting



3 2j uoband
2 ~

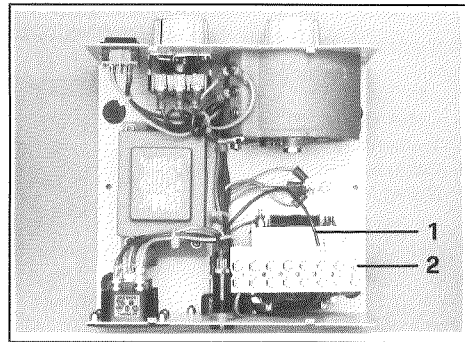
Control Unit, Bottom

Fig. 19
1 Screws



Control Unit, Cover Removed

Fig. 20
1 Brown lead
2 Clamping screws



5.2 ADDITIONAL EQUIPMENT

5.2.1 Transmitted lighting

NOTE

This section only deals with accessories that are widely used and generally remain installed permanently.

CAUTION

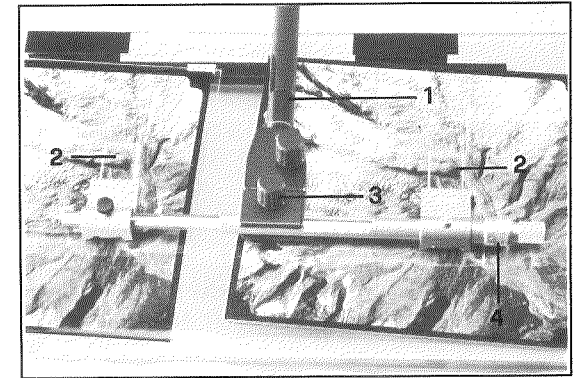
The equipment is set at the factory for connection to 220V AC. If your mains supply differs from 220V ± 10% you must change the setting of the control unit!

5.2.1a Adjustment to your mains voltage

- 1) Loosen two screws (19/1) and remove cover of control unit.
- 2) Loosen brown lead (20/1). Place it in the desired voltage connection (e.g. 115 V) and tighten clamping screw (20/2).
- 3) Replace cover of control unit.
- 4) Mark "selected voltage" on the back of the control unit (18/1).

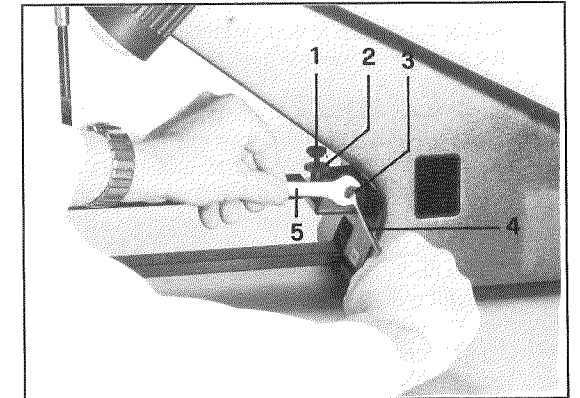
Stereomicrometer Holder with Stereomicrometer

Fig. 21
1 Stereomicrometer holder
2 Measuring mark glass plates
3 Clamp
4 Stereomicrometer



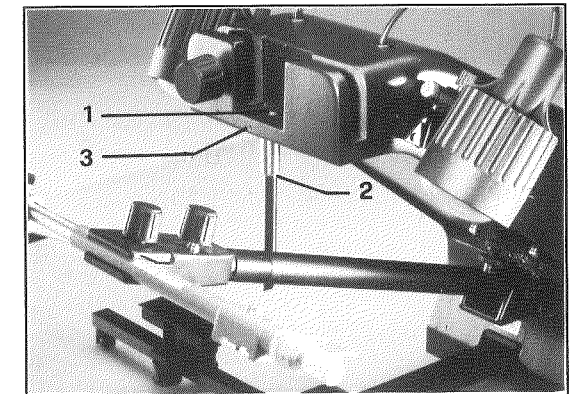
Attaching Stereomicrometer Holder

Fig. 22
1 Adjustment screw
2 Counterscrew
3 Conical-end screw and nut
4 Screwdriver, 3 mm
5 Spanner, 10 mm



Stereomicrometer in Standby Position

Fig. 23
1 Opening
2 Stop for stereomicrometer holder
3 Setscrew



5.2.1b Installation

- 1) Peel off protective foil and slide transmitted lighting (17/2) into picture carriage.
- 2) Connect control unit to mains (mains cable not supplied) and plug cable (17/3) into socket (18/3).

5.2.2 Stereomicrometer

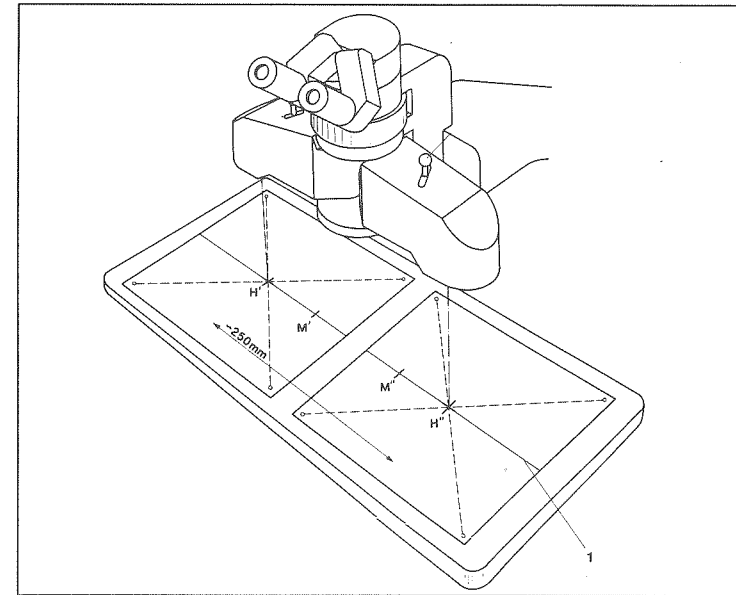
- 1) Attach stereomicrometer holder (21/1) to stereoscope carrier with two conical-end screws (22/3). Adjust screws to allow easy up and down movement of the holder, but without lateral slack.
- 2) Slide measuring mark glass plates (21/2) into stereomicrometer (21/4). Open clamp (21/3), insert and clamp stereomicrometer to head of holder.
- 3) Adjust screw (22/1) and counterscrew (22/2) to set height so that the measuring mark plates move just clear of the photographs.
- 4) Insert stop (23/2) into opening (23/1) and secure by setscrew (23/3). Ensure that notch faces right so that stereomicrometer holder can engage in its raised position. If it does not engage properly, displace holder by slackening one of the conical-end screws and tightening the other. Secure screws by hexagonal locknuts (22/3).

5.2.3 Special eyepieces

To exchange eyepieces: simply slacken clamping screws (16/6) and pull out the standard eyepieces. Insert special eyepieces and tighten clamping screws.

Photographs Positioned on Picture Carriage

Fig. 24

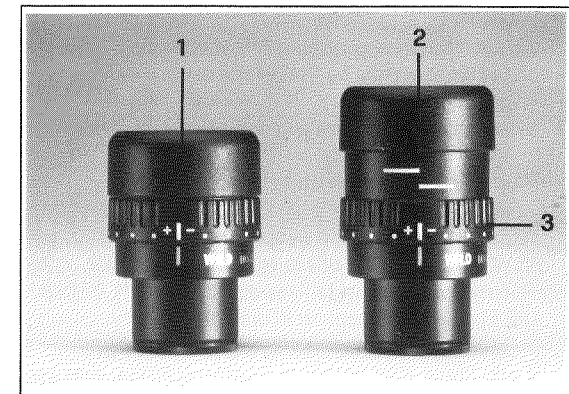


- 1 Flightline denoted on photo
- H' = principal point of left photo
- H'' = principal point of right photo
- M' = principal point of right photo transferred to left photo
- M'' = principal point of left photo transferred to right photo

Eyepieces

Fig. 25

- 1 Eyecup, fully down
- 2 Eyecup, fully up
- 3 Eyelens mount with dioptic scale set to zero



6 INTERPRETATION AND MAPPING

6.1 REQUIREMENTS FOR PHOTOGRAPHIC MATERIAL

The APT2 can be used for viewing any pair of stereophotographs, within very wide limits:

The scale of the two photographs should not differ by more than about 15% to 20%.

The camera base (distance between the camera stations) ought not to be too large relative to the distance to the object photographed and its depth.

The vertical parallax difference due to camera tilt should not exceed ± 38 mm.

6.2 STEREOSCOPIC VIEWING OF AERIAL PHOTOGRAPHS

For the best possible three-dimensional effect, the photographs must be correctly oriented and focused (Fig. 24).

6.2.1 Preparing the photographs

- 1) Connect the four fiducial marks of each photograph and mark the intersections as principal points H' and H".
- 2) By means of the photographic details in the vicinity of the principal points, transfer the principal point H' of the left-hand photograph to the right-hand photograph M", and similarly transfer the principal point H" of the right-hand photograph to the left-hand photograph M'.

6.2.2 Orienting the photographs

Position the photographs on the picture carriage in such a way that:

- 1) The overlap zone lies toward the center (the spatial effect is enhanced if the shadows fall toward the observer).
- 2) The four points H'-M" and H"-M' lie on a straight line (24/1), parallel to the picture carriage.
- 3) The distance between principal points H' and H" is about 250 mm.
- 4) Secure the photographs with suction cups, adhesive tape or glass cover plates so that they lie flat on the picture carriage.

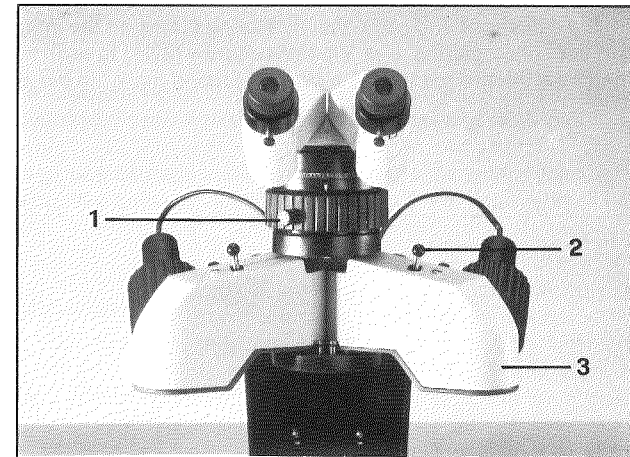
6.2.3 Viewing and interpreting the photographs

- 1) Plug in and/or switch on lighting.
- 2) Adjust space between eyepiece tubes to match your eyebase (5/2).
- 3) Adjust eyecups: low with spectacles (25/1), higher without spectacles (25/2). Twist eyecups to secure them in the raised position.
- 4) If you know your personal dioptric settings, turn eyelens mounts to appropriate diopter values. Otherwise set them to zero (25/3).

- 5) Slacken clamping screw (26/1) and turn ring to set zoom to maximum magnification 15.5 x. Use focusing levers (26/2) to compensate for different thicknesses of photographs and cover glass plates.
- 6) Set zoom to minimum magnification 3.1x and turn each eyelens mount (25/3) individually until the picture appears sharp.
- 7) Set zoom to 15.5 and adjust with focusing levers if necessary.
- 8) Set zoom to magnification appropriate for your task.
- 9) Lower levers (15/3) to move picture carriage and scan your stereomodel. If left and right image do not fuse, pivot viewing arms (26/3).

Optics

Fig. 26



- 1 Clamping screw
- 2 Focusing levers
- 3 Viewing arms

NOTE

A stereoscopic effect is easiest to obtain in the centre of the stereomodel. In the corners of "difficult" photographs, i.e. those with extreme height differences or where the camera axes are not parallel, excessive parallax may occur. In this case you have to readjust the position of the viewing arms.

- 10) Mark the results of your interpretation directly on the photographs, or on transparent overlays. For special tasks involving additional equipment refer to subsequent sections of this manual.
- 11) When you stop working
 - switch off lighting
 - block picture carriage
 - protect instrument with dust cover.

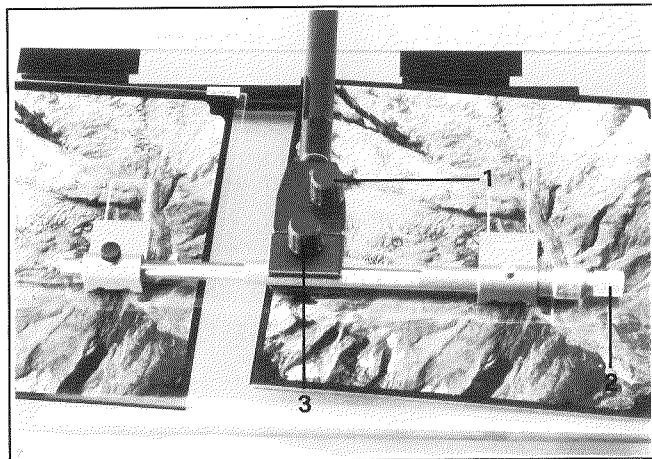
6.3 SIMPLE MAPPING

6.3.1 Using the stereomicrometer

- 1) Loosen clamping screw (27/3) and adjust spacing of measuring marks roughly to the instrument base (about 250 mm). Tighten screw again.
- 2) Look through the eyepieces and place the measuring marks on the image of the same point in both photographs. Use Y-parallax screw (27/1) to align and micrometer screw (27/2) to fuse the two marks into a single "floating mark" in the stereomodel.

Stereomicrometer

Fig. 27



- 1 Y-parallax screw of stereomicrometer holder
- 2 Micrometer screw
- 3 Clamping screw for approximate setting

NOTE

Beginners may find it easier to work monocularly at first: Place right mark on chosen image point. Check position of left mark relative to chosen image point.

If left mark is "behind", turn Y-parallax screw anticlockwise.

If left mark is "in front", turn Y-parallax screw clockwise.

If left mark is to the left, turn micrometer screw counterclockwise.

If left mark is to the right, turn micrometer screw clockwise.

Practise moving the floating mark up and down in the stereomodel by turning the micrometer screw and trying to land the mark on the surface of the terrain. When the floating mark is precisely on the surface, the two measuring marks are on exactly the same spot in both photographs.

6.3.2 Plotting the picture contents

- 1) For planimetric plotting on a sheet placed to the right of the picture carriage, fit the stereomicrometer with the right-hand measuring mark only.
- 2) Move the picture carriage in such a way that the measuring mark is guided along the outline of the required object in the right-hand picture.

NOTE

Such a plot will correspond with the right-hand aerial photograph, i.e. its projection is distorted compared to a topographic map. An elegant method of plotting the picture contents without distortion is to use a pair of stereo-orthophotos instead of a normal pair of stereophotographs (see section 6.3.3).

6.3.3 Working with stereo-orthophotos

Stereo-orthophotos comprise an orthophoto and a stereomate, both produced in a digitally-controlled orthophoto equipment such as the WILD OR1. The stereomate is a photograph made from an orthophoto by the introduction of artificial parallax, in order to produce a stereoscopic effect when viewed together with the orthophoto.

Stereo-orthophotos show planimetric details in their true positions and thus greatly simplify the transfer of interpretation results to the map. For interpretation it is preferable to work at an enlarged image scale so the details contained in the photographs will be easier to mark. However, the pairs of stereorthophotos have to fit the size of the APT2 picture carriage and respect the 250 mm instrument base. This can be done either subsequently by trimming the material to size or taken into account when the orthophoto and its stereomate are being produced.

Transfer points H'- M' and H"- M" from the aerial photographs and orient as per 6.2.2, with orthophoto on the right and stereomate on the left.

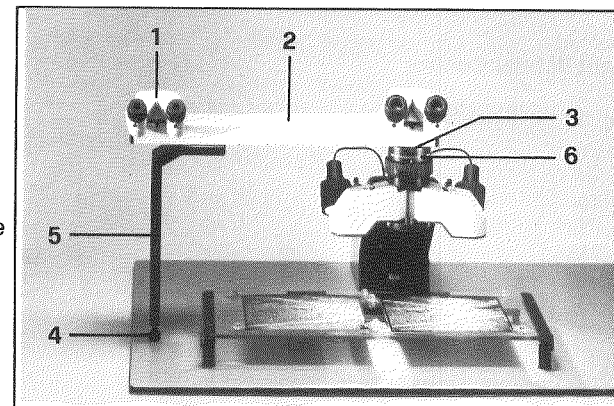
6.3.4 Plotting form lines

- 1) Fit the stereomicrometer with both measuring mark plates as per 5.2.2.
- 2) Keep the stereomicrometer fixed while moving the picture carriage in such a way that the floating mark remains constantly on the ground.

APT2 with Discussion Tube

Fig. 28

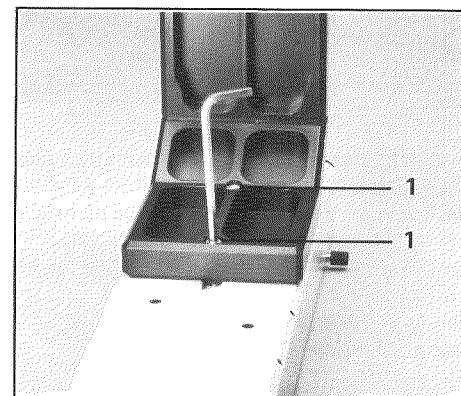
- 1 Inclined binocular tube for second observer
- 2 Discussion tube
- 3 Clamping screw
- 4 Adjustable foot
- 5 Support for discussion tube



Fitting the Support to the Discussion Tube

Fig. 29

- 1 Allen screw
(2 pieces)



6.4 DISCUSSION AND TRAINING

6.4.1 Fitting and using the discussion tube

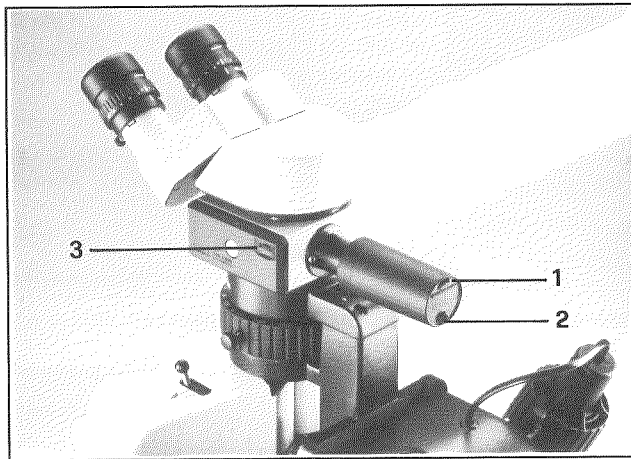
- 1) Fit support (28/5) to discussion tube (28/2) as shown in Fig. 29. Note that the discussion tube is supplied with an adapter plate for stereomicroscopes which you do not need.
- 2) Slacken clamping screw (28/3) and remove binocular tube from optics carrier.
- 3) Fit discussion tube on optics carrier. Hold it level and without twisting. Unscrew rubber foot (28/4) until the discussion tube is held in this position without undue strain. Tighten clamping screw (28/3).

NOTE: Milled rings (30/3) at both ends of the discussion tube serve to swing light excluders into the beam paths so that light entering the eyepieces from the outside is blocked. Turn milled ring clockwise to cut out stray light, and anticlockwise for observation.

Light Pointer Control

Fig. 30

- 1 Catch for cover of battery compartment
- 2 Push-button
- 3 Milled ring for light excluder

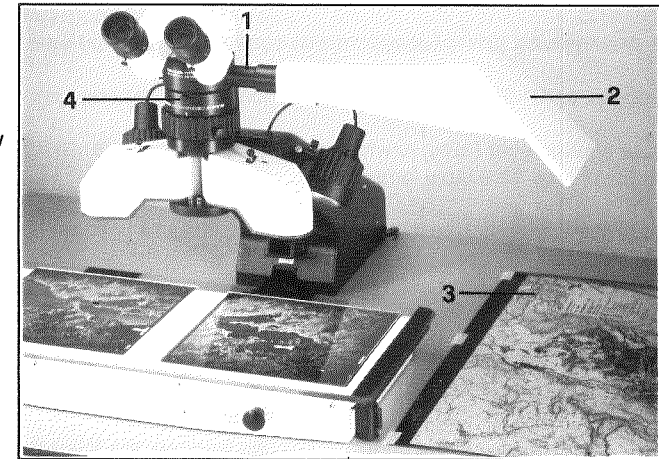


- 4) Fit both binocular tubes and secure them with their clamping screws. Provided that the discussion tube is held in the optics carrier without strain or twisting, the adjustment carried out in accordance with 6.2.3 will be retained for the first observer.
- 5) Insert eyepieces and adjust them for the second observer.
- 6) Press catch (30/1) and pull off the battery compartment cover. Insert two 1.5 V batteries (size AA). Replace cover.
- 7) Push button (30/2) to activate light pointer. Press quickly for pulsating light Press longer for continuous light Press again to switch off (extinguishes automatically after 75 seconds).
- 8) Turn light pointer control about its axis and tilt it to orient and position the pointer.

APT2 with Drawing Tube

Fig. 31

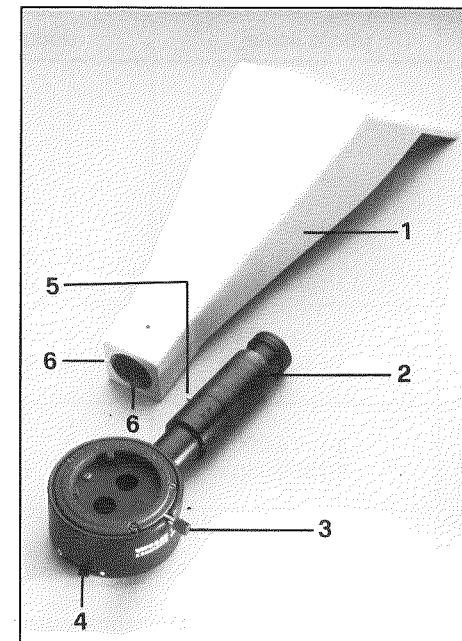
- 1 Drawing tube
- 2 Mirror
- 3 Document
- 4 Clamping screw



Drawing Tube

Fig. 32

- 1 Mirror
- 2 Objective
- 3 Clamping screw
- 4 Shutter lever
- = open
- = closed
- 5 Bolt
- 6 Notch



6.5 COMPARING AND REVISING DOCUMENTS

6.5.1 Fitting and using the drawing tube

- 1) Fit drawing tube (31/1) between optics carrier and binocular tube.
- 2) Slide mirror (31/2) over drawing tube so that bolt (32/5) engages notch (32/6).
- 3) Move shutter lever (32/4) to white dot so that document (31/3) is imaged in the right eyepiece. Use table lamp to illuminate document.
- 4) Move objective (32/2) to focus document.
- 5) Adjust zoom setting to match photo scale to document scale. Orient document relative to photo and fasten it on table.

NOTE

For a document layed out on the aluminium worktop, the following scale relationships apply:

Document scale = 1.4 • zoom • photo scale

Photo scale number = 1.4 • zoom • document scale number

zoom	photo scale	document scale
3.1	1 : 10 000	1 : 2 300
	1 : 20 000	1 : 4 610
	1 : 21 700	1 : 5 000
	1 : 30 000	1 : 6 910
	1 : 40 000	1 : 9 220
	1 : 43 400	1 : 10 000
	1 : 86 800	1 : 20 000
	1 : 108 500	1 : 25 000
3.6	1 : 25 000	1 : 5 000
	1 : 100 000	1 : 20 000
10	1 : 14 000	1 : 1 000
	1 : 100 000	1 : 5 000
15.5	1 : 50 000	1 : 2 300
	1 : 108 500	1 : 5 000

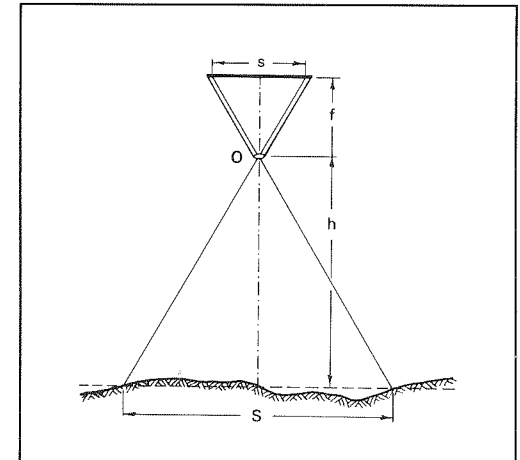
6.6 VIDEO RECORDING AND PROJECTION

7 MEASUREMENTS FROM PHOTOGRAPHS AND IN THE STEREOMODEL

7.1 DETERMINING PHOTO SCALE

Fig. 33
Geometrical relationship in vertical photographs

- M Photo scale
- m Scale number
- S Ground distance
- s Distance in photograph
- h Height of aircraft above ground
- f Focal length of camera lens



The so-called normal case in photogrammetry, in which the two camera axes are parallel to each other and perpendicular to the camera base, is the simplest relationship between photographs and object. Vertical aerial photographs provide a fair approximation of this condition.

From figure 33 we obtain the following ratios: $M = 1 : m = \frac{s}{S} = \frac{f}{h}$

Numerical examples

1) If flying altitude is known

$$f = 214.88 \text{ mm}$$

$$h = 590 \text{ m}$$

$$M = \frac{215}{590\,000} = 1 : 2740$$

From photo-to-ground

2) distance relationship

$$s = 117 \text{ mm}$$

$$S = 320 \text{ m}$$

$$M = \frac{117}{320\,000} = 1 : 2735$$

NOTE

The scale can be the same throughout a photograph only if the ground is perfectly flat and level.

As a rule, the aircraft's height above ground is either unknown or not known accurately enough. It is always advisable, therefore, to determine the photo scale by means of a known distance, such as the interval between the pylons carrying high-tension cables, the distance between the surveyed control points, etc. The greater the distance used for reference, the more accurately the scale can be determined. For the accurate measurement of distance in the photographs, it is advisable to use a glass scale and magnifying glass.

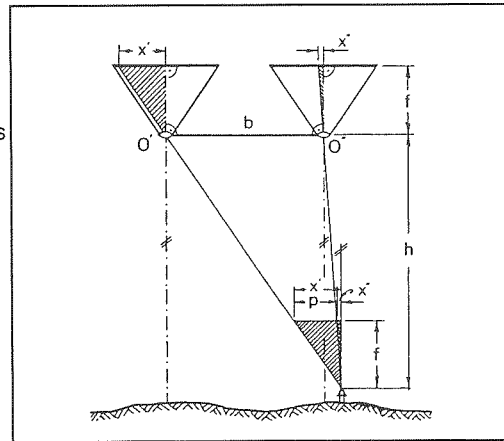
7.2 PARALLAX MEASUREMENT

- 1) Fit stereomicrometer as per 5.2.2.
- 2) Use micrometer screw (8/3) to set the left and right measuring mark on identical points. Read and note the parallax, first and second digits on millimeter scale (8/5), third and fourth against index on micrometer drum (8/4).
- 3) Measure parallax in each height reference point and in all unknown points. Compute height differences as shown in the next chapter.

Image of a Ground Point

Fig. 34

- b Camera base
- p Parallax, i.e. the difference in positions $x'' - x'$ of the same point in the two photographs



7.3 DETERMINING HEIGHT DIFFERENCES

7.3.1 Formulas

From figure 34, we obtain the following ratios:

$$\frac{h}{f} = \frac{b}{p} \quad \text{or} \quad h = \frac{f \cdot b}{p} \quad (1)$$

To determine height differences that are relatively small compared with the aircraft's height above ground, we can use height datum H_0 to develop the following series from equation (1):

$$\Delta H = \frac{H_0^2}{f \cdot b} \Delta p + \dots$$

- ΔH Height difference on ground
 - H_0 Datum, i.e. ground level of reference point
 - Δp Parallax difference
- (2)

In other words, a first approximation for small height differences shows that they are proportional to the parallax difference:

$$\Delta H = C \cdot \Delta p$$

where:

C Proportional constant

By identifying two points of known height in the stereomodel and using the stereomicrometer to measure their parallax difference, we can compute C:

$$C = \frac{\Delta H}{\Delta p} = \frac{H_B - H_A}{p_B - p_A}$$

where:

H_A Height of ground point A

H_B Height of ground point B

p_A Parallax at A as measured by stereomicrometer

p_B Parallax at B as measured by stereomicrometer

Hence the height of any point N relative to the datum H_A is:

$$\Delta H_N = C \cdot \Delta p$$

We obtain the height above mean sea level from:

$$H_N = H_A + C \cdot (p_N - p_A)$$

where:

H_N Height of point to be determined

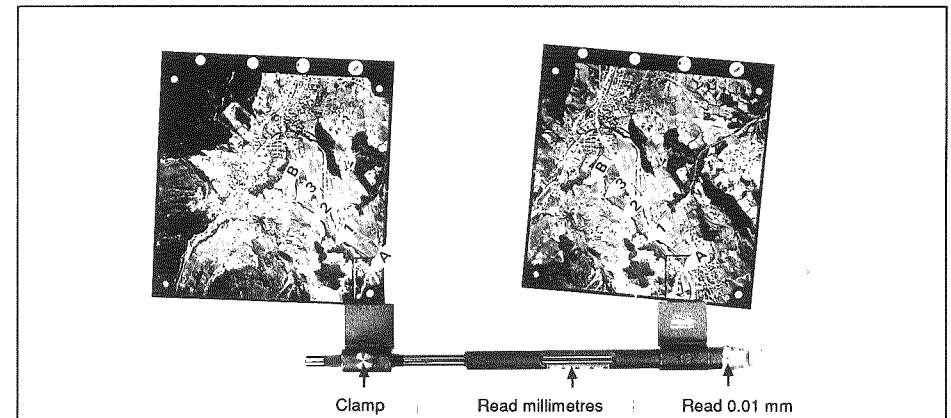
H_A Height of known point

p_N Parallax at N as measured by stereomicrometer

p_A Parallax at A as measured by stereomicrometer

Determining Ground Height

Fig. 35



7.3.2 Typical example of restitution

Known: Height H_A and H_B of points A and B
Obtain: Heights H_N of points 1, 2, 3

- 1) Measure parallax at points A and B by stereomicrometer readings.

NOTE: A is the lowest point. Its height is taken as datum. This ensures that all height and parallax differences are positive.

Point	Height (m)	Parallax (mm)
A	505 (H_A)	6.36 (p_A)
B	670 (H_B)	11.55 (p_B)
Difference	165 ($H_B - H_A$)	5.19 ($p_B - p_A$)

- 2) Compute proportional constant: $C = \frac{\Delta H}{\Delta p} = \frac{165}{5.19} = 31.8 \text{ m/mm}$

- 3) Measure parallax p_N at points 1, 2, 3.
Compute parallax differences $p_N - p_A$.
Compute height differences $\Delta H_N = C \cdot (p_N - p_A)$.
Compute heights $H_N = H_A + \Delta H_N$.

Point	p_N	$p_N - p_A$	ΔH_N	H_N
1	7.48	1.12	36	541
2	10.04	3.68	117	622
3	11.03	4.67	148	653

7.3.3 Accuracy

Because higher-order terms are disregarded in equation (2), there is a height error:

$$F_{\Delta H} = \frac{\Delta H^2}{H_0}$$

A careful choice of control points can keep height errors to a minimum where large height differences occur, and it also reduces errors due to the inevitable change of attitude of the aircraft. If the points to be found lie near the line connecting known points, as shown in figure 35, interpolation produces results that are practically error-free.

7.4 MEASUREMENTS USING GRATICULES

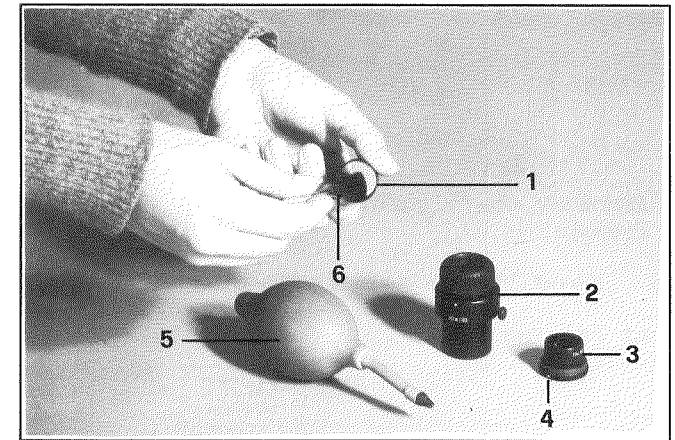
7.4.1 Fitting eyepiece graticules for measuring and counting

- 1) Make sure that graticule is clean. If necessary remove stains with lens tissue (11/4) and dust with blow-bulb (36/5) or lens brush (36/6).
- 2) Unscrew sleeve (36/3) from eyepiece. Fit graticule mount over sleeve (Fig. 37) and align reticle pattern relative to white dot (36/4).
- 3) Screw sleeve with graticule into eyepiece (Fig. 38).

Cleaning the Eyepiece Graticule

Fig. 36

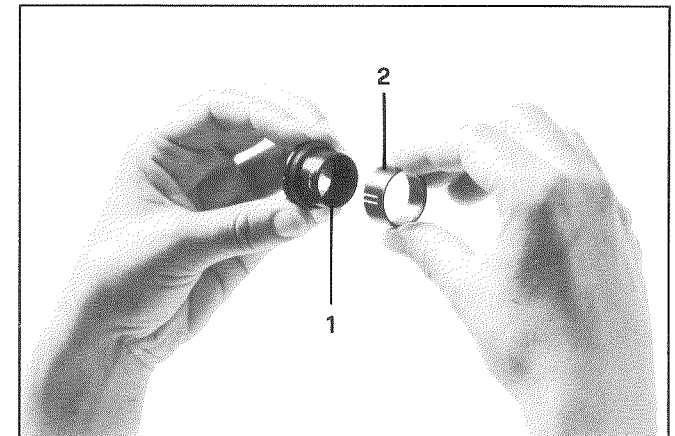
- 1 Graticule, in mount
- 2 Eyepiece
- 3 Sleeve
- 4 White dot
- 5 Blow bulb
- 6 Lens brush



Fitting the Graticule to the Sleeve

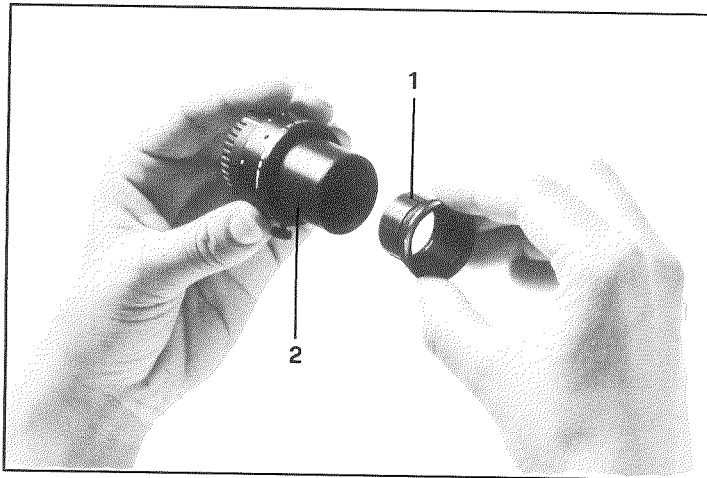
Fig. 37

- 1 Sleeve
- 2 Graticule, in mount



Fitting the Sleeve to the Eyepiece

Fig. 38



- 1 Sleeve with mounted graticule
- 2 Eyepiece

- 1) Sleeve (38/1) with mounted graticule screwed into eyepiece (38/2).

7.4.2 Focusing

NOTE

The optical path carrying the graticule must be focused carefully to avoid optical parallax between graticule and object (photograph or stage micrometer).

- 1) Turn eyelens mount until graticule is in focus.
- 2) Place stage micrometer on picture carriage where you can see it along with the graticule.
- 3) Set zoom to maximum magnification. Use focusing lever to bring stage micrometer into focus. Ensure freedom from parallax: move your head slightly from side to side - there should be no apparent movement between the images of graticule and stage micrometer. If there is movement, repeat steps 1 to 3.
- 4) Set zoom to minimum magnification and adjust eyelens mount of the second eye piece.

7.4.3 Calibrating graticules

NOTE

Calibration is necessary for determining absolute length values and areas at ground scale. Whenever you use a different graticule, change the instrument's magnification, or use a different photo scale, you have to calibrate again.

7.4.3.1 Graticule with scale

- 1) Set desired magnification and clamp zoom setting.
- 2) Place stage micrometer on picture carriage, parallel to the graticule so that the rulings of the two coincide at one point (Fig. 39).
- 3) Count how many intervals in the graticule (y) correspond to a given number of 0.1 mm intervals in the stage micrometer (x).

- 4) Compute
$$g = i \cdot \frac{x}{y}$$

g = graticule interval at photo scale

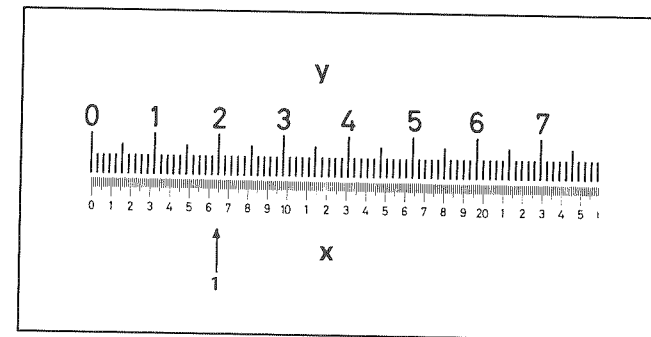
G = graticule interval at ground scale

m = photo scale number

i = stage micrometer interval = 0.1 mm

Calibrating the Graticule Scale

Fig. 39



y Eyepiece graticule

x Stage micrometer, interval $i = 0.1$ mm

m Photo scale number = 1900

O (y) coincides with O (x)

61 (y) corresponds to $200 \cdot (x)$

G = graticule interval at ground scale = 0.62 mm

$$G = m \cdot i \cdot \frac{x}{y} = 1900 \cdot 0.1 \text{ mm} \cdot \frac{200}{61} = 623 \text{ mm}$$

7.4.3.2 Graticule with grid

- 1) Set desired magnification and clamp zoom setting.
- 2) Place stage micrometer on picture carriage, parallel to the graticule so that the rulings of the two coincide (Fig. 40).
- 3) Count how many grid squares in the graticule (y) correspond to a given number of 0.1 mm intervals in the stage micrometer (x).

4) Compute $a = i \cdot \frac{x}{y}$

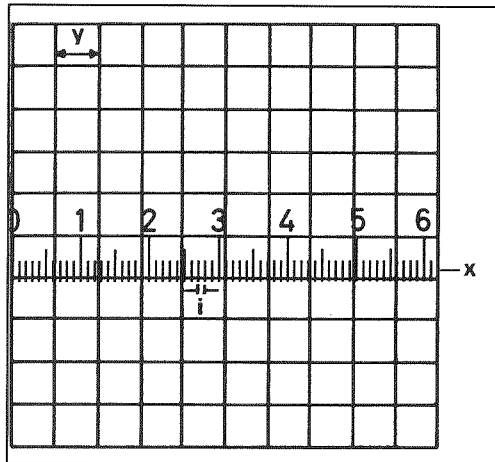
a = grid interval at photo scale
 A = grid interval at ground scale
 m = photo scale number
 i = stage micrometer interval

- 5) Compute $A^2 =$ ground area of one grid square.

Calibrating the Graticule Grid

Fig. 40

y Graticule grid
 x Stage micrometer, interval = 0.1 mm
 m Photo scale number = 5000



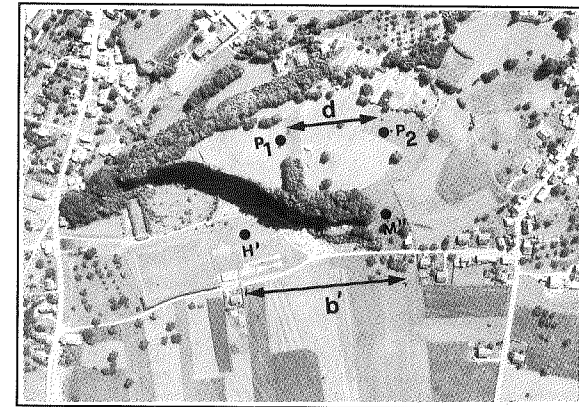
10 (y) grid squares correspond to 62 (x) stage micrometer intervals

$$A = 5000 \cdot 0.1 \text{ mm} \cdot \frac{62}{10} = 3.1 \text{ m} = \text{grid interval at ground scale}$$

$$A^2 = 9.6 \text{ m}^2 = \text{ground area of one grid square}$$

Slope Measurement

Fig. 41



f camera focal length = 153 mm
 b' camera base in left photo = 89 mm
 d distance defining the slope = 38 mm
 dp parallaxe difference = 4.80 mm

$$\tan \vartheta = \frac{153 \cdot 4.80}{89 \cdot 38} = 0.2171 \implies \vartheta = 3.8^\circ$$

7.4.4 Determining length and distances

- 1) Fit appropriate eyepiece graticule (see 7.4.1).
- 2) Focus (see 7.4.2)
- 3) Calibrate graticule (see 7.4.3.1)
- 4) Align graticule with object to be measured.
- 5) Read number of intervals and multiply by G.

7.4.5 Determining slope angles

- 1) Use graticule to determine distance d defining the slope between points P1 and P2 (see Fig. 41).
- 2) Measure photo base b' using a glass scale.
- 3) Use stereomicrometer to measure parallax difference dp between points P1 and P2.

- 4) Compute slope ϑ in degrees from
$$\tan \vartheta = \frac{f \cdot dp}{b \cdot d}$$

7.4.6 Measuring areas

- 1) Fit appropriate eyepiece graticule (see 7.4.1).
- 2) Focus (see 7.4.2).
- 3) Calibrate graticule (see 7.4.3.2).
- 4) Position grid over object to be measured.
- 5) Count number of grid squares and multiply by A².

7.4.7 Counting objects

- 1) Fit appropriate eyepiece graticule (see 7.4.1).
- 2) Focus (see 7.4.2).
- 3) Set desired magnification and position grid over area to be sampled.
- 4) Count objects of interest, proceeding systematically from one grid square to the next.

8 MAINTENANCE

8.1 CLEANING

- 1) Use dust cover during pauses in work.
- 2) Protect open optics (binocular tube, eyepieces, optics carrier when not in use) by means of the covers provided.
- 3) Remove dust from optics with blow-bulb or lens brush, and stains with lens tissue.
- 4) Clean mechanical parts with soft cloth.

CAUTION

Do not grease, oil or apply chemical solvents.

Never dismantle optical or mechanical parts unless instructions for doing so are given in this manual.

