ASAHI PENTAX

PENTAX 100

EQUATORIAL-MOUNT REFRACTING TELESCOPE

OPERATING MANUAL

PENTAX 100

You have just purchased one of the finest equatorial-mount refracting telescopes available. The lenses and mechanical features of the PENTAX 100 are highly refined and precision products which will deliver years of reliable performance if well taken care of.

Please read this instruction manual carefully in order to fully understand how to operate and realize the enormous potential of your new telescope.

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1. MAIN PARTS AND ACCESSORIES

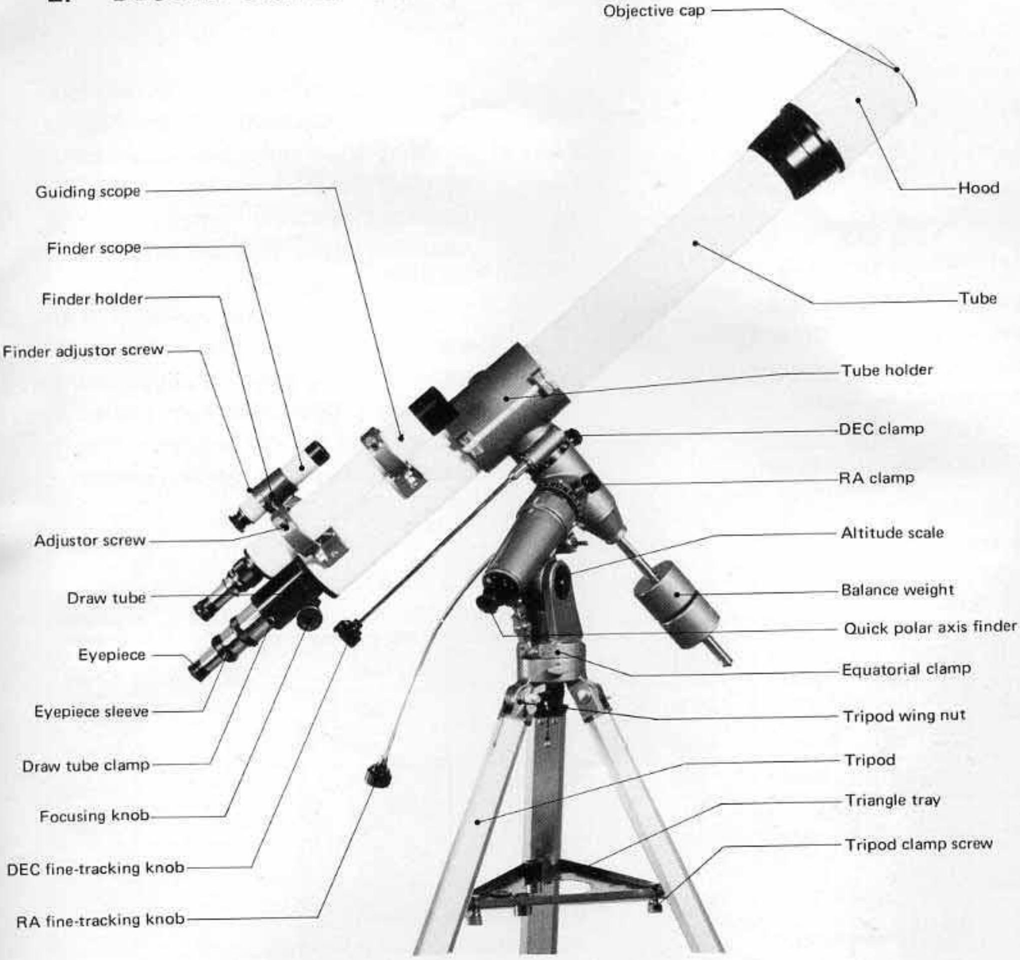
1. Main Body

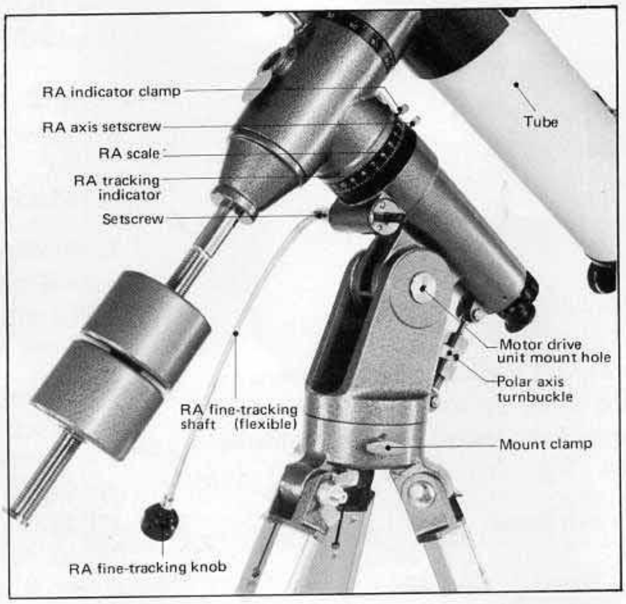
Telescope tube (with finder scope and guiding scope) . . . . 1 set
Equatorial mount . . . . 1 set
Tripod (with triangle tray) . . . . 1 set

2. Standard Accessories

Eyepieces (Or-5, Or-6, K-9, K-12.5, K-25) . . . . 5 pcs.
Star diagonal . . . . 1 pc.
Sun screen . . . . 1 set
Sun glass . . . . 1 pc.
Telescope tube case . . . . 1 pc.
Mount cover . . . . 1 pc.

2. DESCRIPTION OF PARTS





3. FEATURES AND SPECIFICATIONS

1. Objective lens

Type: 2 elements, achromatized
Effective aperture: 100 mm
Focal length: 1,200 mm
Relative aperture: 1 : 12
Resolving power: 1.16" (Note 1)
Limiting visual magnitude: 12.1 (Note 2)
Light gathering power: 204 X (Note 3)

(Note 1) The resolving power of an objective is usually determined by Dawes' formula

$$\frac{11.6''}{\text{Effective aperture of objective in cm}}$$

which expresses the limit of resolvable distance (in seconds) between 2 points.

(Note 2) Limiting visual magnitude is determined by observing stars near the zenith with a medium-magnifying eyepiece on a clear, moonless night. It is expressed by the formula:
$7.1 + 5 \log D$ (cm), where D is the aperture of the objective.

(Note 3) Light gathering power is determined by how many times more light a telescope gathers than the eye (assuming that the pupil of the eye is 7 mm in diameter).

2. Eyepieces Table 1.

Type	Lens elements	Focal length	Magnification	Mag. per cm of aperture	Apparent field of view	Real field of view	Eye ring diameter
Orthoscopic	4	5mm	240x	24x	40°	10′	0.42mm
Orthoscopic	4	6mm	200x	20x	40°	12′	0.5mm
Kellner	3	9mm	133x	13.3x	45°	20′	0.75mm
Kellner	3	12.5mm	96x	9.6x	45°	28′	1.04mm
Kellner	3	25mm	48x	4.8x	46°	57′	2.08mm

3. Finder scope

Objective lens: 2 elements, achromatized
Effective aperture: 30 mm
Magnification: 6 X
Real field of view: 7°10′
Eye ring: 5 mm

*This finder scope incorporates a reticle focusing plate.

4. Guiding scope

Objective lens: 2 elements, achromatized
Effective aperture: 50 mm
Magnification: 32 X
Real field of view: 1°24′
Eye ring: 1.6 mm

* The eyepiece of the guiding scope incorporates a reticle focusing plate; by adding a few optional parts it can easily be converted into an illuminated reticle eyepiece.

5. Quick polar axis finder

Field of view: 3°24′
Central area of subdued brightness: 1°

6. Equatorial mount

Adjustable range of polar-axis: 20° ~ 54°
Horizontal rotation of mount: 360°
Fine tracking capability for the entire circumference of right ascension and declination: 10′
(With vernier 2′)
Minimum graduation of right ascension (RA) scale: 2°
(With vernier 0.5°)

7. Alignment of Optical Axis

Optical axis of the objective lens can be realigned with 3 sets of adjustor screws in the lens cell. (See page 27 for details.)

8. Options

(A) Pedestal for fixed point observation (exclusively designed for 10 cm model)
(B) Turnbuckle for low latitudes (0° ~ 35°)
(C) Synchronized motor for driving polar axis

* Other optional accessories are the same as for the 85 mm refracting equatorial.

9. Dimensions and weight

Telescope tube:	Overall length, 1,310 mm weight, 5.9 kg.

Equatorial mount (at 35° latitude)
Overall height, 530 mm; weight, 13.6 kg.

Tripod (23° angle between legs):	
	Overall height, 1,340 mm weight, 4 kg.

4. ASSEMBLY AND PREPARATIONS

1. Assembly of Equatorial Mount and Tripod

(1) Open the carton and check to see if all parts are included. You begin assembling the telescope by erecting the equatorial mount and the tripod.

(2) Lay the equatorial mount on the floor. Take one leg of the tripod and fit its head into the uppermost socket of the mount. The leg should be fitted so that its L-shaped metal fitting for carrying the triangle tray is turned inside.

(3) Insert a tripod bolt into the socket from left. Put a washer and a wing nut onto the bolt shaft appearing on the other side of the socket, and screw lightly.

* Make sure that the stopper on the bolt fits properly into the groove of the socket. If not, a gap will be left between the head of the bolt and the socket. The position of the stopper can be adjusted by slightly turning the bolt head.

(4) When you have finished mounting one leg, loosen the horizontal clamp of the mount, turn the socket base 120 degrees and bring the next socket to the upper position. Mount the remaining two legs in the same manner as the first.

(5) After fitting all legs, stand the tripod in upright position. Next, tighten all clamps on the equatorial mount. Take care not to let the tips of the tripod legs slip when standing the tripod upright on a smooth floor.

(6) Place the triangle tray on the L-shaped metal fittings of the legs. Slip a clamp screw for the tray in the guide groove of the fitting and screw lightly. Do likewise with all fittings.

(7) After the 3 clamp screws have been inserted, pull the legs of the tripod outwards one by one. The clamp screws will then settle into their correct places in the metal fittings. Tighten the clamp screws, and then tighten the wing nuts at the top of the legs. The equatoral mount will now stand firmly.

2. Mounting the Fine-Tracking Knobs

(1) Loosen the setscrew on the RA fine-tracking knob (flexible shaft type) and fit it into the axis of the RA worm gear. The setscrew must come into contact with the flat part of the axis. Screw tightly.

(2) Likewise, fix the DEC fine-tracking knob on its axis.

3. Mounting Balance Weights

(1) Fix the DEC axis with the tube holder turned upwards.

(2) There is a hole for screwing in the rod carrying the balance weights. Carefully screw the rod into the axis, holding the balance weights in your left hand and the lower end of the rod in your right hand.

(3) Screw tightly by inserting the accessory turning bar into the hole of the threaded rod.

4. Mounting the Telescope Tube

(1) Loosen the tube clamp and completely open the tube holder. Insert the telescope tube so that the holder grips the tube near its center (slightly towards the lower end). Close the holder and clamp it tightly.

* The eyepiece end of the tube fits on the same side as the fine-tracking knobs.

(2) Mount the finder scope securely on the tube using the setscrews attached to the tube.

5. Balance Adjustment of the Tube

(1) Loosen the RA clamp, set the DEC axis horizontal and clamp tightly.

(2) Loosen the DEC clamp gradually and observe the movement of the tube.

(3) If the objective lens should tilt down to one end, that end is too heavy. Loosen the tube holder clamp and shift the tube somewhat in the other direction. Retighten the clamp when the tube is balanced properly.

6. Balance Adjustment of the DEC Axis

(1) After adjusting the balance of the tube, adjust the balance of the DEC axis by setting the tube at 0° declination and tighten the DEC clamp.

(2) Then gradually loosen the RA clamp. Either the longer tube end or the end with the balance weights will tilt down.

- If the balance weight end tilts down, turn the weights toward the center of the mount.
- If the longer tube end tilts down, turn the weights away from the center of the mount.

(3) When equilibrium has been attained, screw the two weights towards each other lightly so that they will not come loose under vibration.

7. Adjustment of the Finder Scope

It is not easy to catch a particular star merely by peeping into the eyepiece during astronomical observation. Hence, we seek an object at first with the finder scope, which has a wide field of view and low magnification. If the object you are observing is large, such as the moon, you can easily place it in the sight, even if the finder scope is somewhat off alignment. But observation of distant stars is difficult with a badly aligned finder scope. The importance of accurately aligning the optical axis of the finder scope cannot be over-emphasized.

(1) The first alignment of the finder scope is made in daylight using a clear object more than one kilometer distant. (Use the 25 mm Kellner [K-25] eyepiece for this purpose). Ideal objects for spotting are the tip of a lightning rod, the corner of a building or a rooftop.

(2) Peep into the finder scope and bring the object into the field of view.

(3) When the object is in the field of view, bring it near the center of the crosshairs in the finder scope by using the fine-tracking knobs.

(4) When the object is centered in the finder-scope, peep into the K-25 eyepiece of the main telescope and focus as best as you can by turning the focusing knob. The object should be somewhere in the field of view. Adjust the telescope so that the object comes roughly to the center of the field.

(5) Then change to the Or-5 mm eyepiece and focus. (The object will probably be somewhat off the field center, because the Or-5 mm eyepiece has a magnification of 240 X as against 48 X of the K-25 mm, and consequently deviation is also magnified 5 times.)

(6) When the object is exactly at the center of the field of the Or-5, peep into the finder scope again and adjust the 3 setscrews until you have the object exactly in the center of the crosshairs.

(7) Peep into the telescope eyepiece and the finder scope alternately until the positions of the object coincide precisely. Then tighten the 3 setscrews with identical force. The alignment of the optical axis is now complete.

(Note 1) The center of the crosshairs in this finder scope is transparent and will not obstruct sighting of distant stars.
The small circle in its field corresponds to the field of a K-25, which has the lowest magnification among accessory eyepieces (48 X).

(Note 2) When you pack the telescope tube back in its case, remove the two mount screws from the finder-scope holder. Save the screws for later mounting. The optical axis can be knocked out of line during re-mounting and may require readjusting.

8. Alignment of the Guiding Scope

A. Guiding the main telescope for astrophotography.

The guiding scope is used to prevent the object under observation from escaping from the center of the field when you photograph it with a camera attached to the eyepiece section of the main telescope. Unlike the optical axis of the finder scope, the optical axis of the guiding scope need not always be perfectly aligned with that of the main telescope.

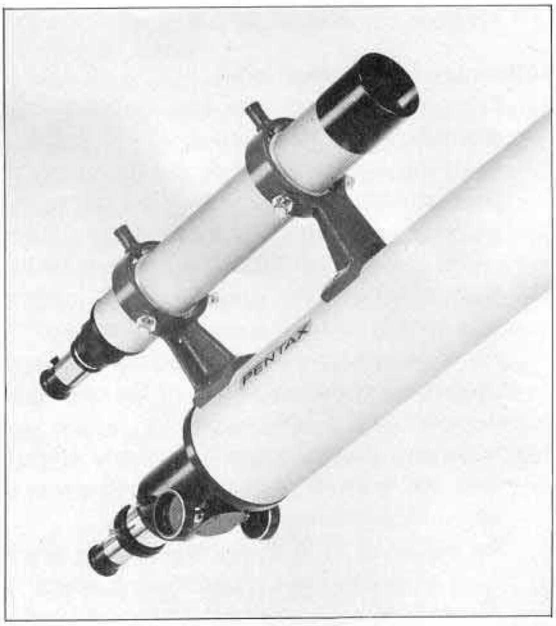
If the object being observed is bright enough to be visible as a point of light in the guiding scope, the optical axis of the guiding scope can be aligned with that of the main telescope. If, however, the object is too faint (below the 9th or 10th magnitude) to be visible with the guiding scope, or if it is somewhat extended like a nebula, guiding is simplified by bringing the guiding scope somewhat off alignment. It is sufficient to bring a distinctly visible object nearby (a fixed star visible as a point of light) into the center of crosshairs.

B. Use of the guiding scope as a low-magnification telescope

Sometimes we want to observe an object at low magnification after having examined it at high-magnification with the main telescope. In such cases it is often simpler to use the guiding scope than to change eyepieces – for example, when we are observing detailed features of the moon at high magnification and then want to observe the moon as a whole; when we want to compare seeing conditions during occultation, or when we want to view the 4 larger satellites of Jupiter after watching the main planet. For these applications, it is helpful to have the optical axis of the guiding scope aligned with that of the main telescope. Then, when a camera is mounted to the main telescope you can observe heavenly bodies through the guiding scope and release the camera's shutter when the object is in optimum focus.

(Adjustment of the guiding scope)

It is often necessary to adjust the guiding scope to meet individual eyesight requirements.



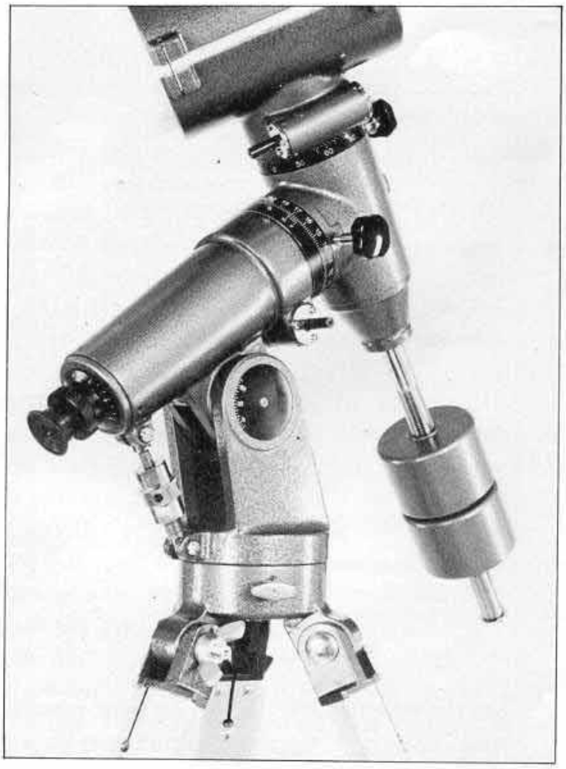
(1) First, bring a fixed star into the center of the crosshairs in the guiding scope.
(2) Turn the focusing ring to "32 X 50" and match the index line to the white circle.
(3) Rotate the eyesight adjustor ring while peeping into the eyepiece until the image of the star comes in sharp.
(4) Shift your eye a little to right and left while sighting the star in the crosshairs. The ideal condition is to have the star and crosshairs coincide with each other, irrespective of the position of your eye. By shifting the eye you will peep into the eyepiece somewhat askew. If the image of the star moves to the left of the center of the crosshairs when the eye is shifted to the left, the crosshairs are too close to the eye; turn the focusing ring somewhat clockwise and re-check. If, on the contrary, the star image moves to the right of the center of the crosshairs when the eye is shifted towards the left, the crosshairs are too far from the eye; turn the focusing ring somewhat counterclockwise and re-check.

(5) When the star image remains stationary regardless of the direction in which the eye is shifted, turn the eyesight adjustor ring until the star image is most distinctly visible. The eyepiece is now adjusted.

(Alignment of the optical axis)

(1) Bring a fixed star into the center of the crosshairs of the finder scope.
(2) Point the main telescope at this star using the Or-6 mm 200X eyepiece. Bring the star to the exact center of the field by carefully maneuvering the RA and DEC fine-tracking knobs.
(3) Next peep into the eyepiece of the guiding scope and bring the star image to the center of the crosshairs by gently turning the right and left setscrews on the nearer of the two rings supporting the guiding scope.
(4) When the guiding scope is perfectly aligned with the main telescope, tighten the round nuts on the setscrews.

* As explained in A above, the guiding scope must be directed to a brighter object nearby if the main object is too faint to be visible with it. The optical axis of the guiding scope is adjustable within a range of $\pm 2^\circ 20'$. This corresponds to about 5 times the minimum magnification circle at the center of the crosshairs in the finder scope (about 30′ in diameter). The reticle eyepiece of the guiding scope is made to the same specifications as the optional illuminated reticle eyepiece (IRK 12.5 mm). Both eyepieces are interchangeable and the illuminated eyepiece can be used by adding its power source and LED connector cord.



9. Alignment of the Polar Axis.

For actual astronomical observation, it is best to point the polar axis exactly at the celestial north pole. In this way, tracking of stars over a long period of time and star-field photography are appreciably simplified.

Prior to the adjustment of the polar axis, make sure that the tripod is firmly standing on the ground and that it is perfectly upright. If the tips of the tripod legs sink into soft ground, push the tripod into the ground as far as it will go so as to prevent further subsidence of legs after the polar axis has been aligned.

The quick polar axis finder has a peephole with a graduated dial for pointing the axis at the Pole Star through the glass plate at the opposite end. Alignment of the polar axis is complicated by the fact that the Pole Star is not located at the exact celestial north pole. The position of the Pole Star as of the 1974.5 epoch was:

RA 2h 02m 01s
DEC +89°08′51″

The Pole Star deviates from the real north pole by about 51′. Consequently, the eyepiece of the quick polar axis finder is approx. 51′ eccentric from the center of the aligning plate. Set the sidereal time dial to your local sidereal time and adjust the direction of the polar-axis so that the Pole Star comes to the center of the aligning plate. The polar axis of the equatorial is now pointed exactly at the celestial north pole.

Calculation of the local sidereal time requires some experience and alignment of the polar axis can be appreciably facilitated if you make a copy of the list on Table 2 and stick it to a leg of the tripod.

Table 2

Reading	Southing Constellations	Principal Stars	Reading	Sounthing Constellations	Principal Stars
0	Cassiopeia, Pisces	β Cas, α And	12	Ursa Major, Virgo	γ UMa, β Leo (Denebola)
1	Andromeda, Pisces	β And, γ Cas	13	Canes Venatici, Virgo	ε UMa, α Vir (Spica)
2	Andromeda, Aries	γ And, α Ari	14	Bootes, Virgo	α Boo (Arcturus)
3	Perseus, Aries	β Per (Algol), α Cet	15	Ursa Minor, Libra	β UMi, α1, α2 Lib
4	Perseus, Aries	Pleiades	16	Corona Borealis, Scorpius	β Sco
5	Auriga, Taurus	α Aur (Capella), β Ori (Rigel)	17	Hercules, Scorpius	α Her (Ras Algethi)
6	Auriga, Gemini	β Aur, α Ori (Betelgeuze)	18	Ophiucus, Sagittarius	γ Dra, γ Sgr
7	Canis Major, Gemini	ζ Gem, α CMa (Sirius)	19	Lyra, Sagittarius	γ Lyr, γ Aql
8	Canis Minor, Cancer	β Gem (Pollux)	20	Cygnus, Sagittarius	α Aql (Altair)
9	Lynx, Cancer	α Cnc	21	Cygnus, Capricornus	α Cyg (Deneb)
10	Ursa Major, Leo	α Leo (Regulus)	22	Pegasus, Aquarius	α Aqr
11	Ursa Major, Leo	α UMa, β UMa	23	Pegasus, Aquarius	α Peg (Markab), β Peg

The readings on this list correspond to the figures on the sidereal time dial of the quick polar axis finder. The position of a fixed star on the celestial sphere is usually expressed by its right ascension (RA) and declination (DEC). The origin of RA (Oh) coincides with the vernal equinox (one of the nodes or the intersections between the equator and the ecliptic, which is at present located in the Constellation of Pisces). When a fixed star is just crossing the local meridian (southing), the RA of that star coincides with the local sidereal time. Hence, you can set the sidereal time dial without a sidereal clock by knowing famous southing stars or constellations. If you have trouble pinpointing south, stand with the Pole Star to your back and pick out one of the 12 constellations of the Zodiac which will be in front of you. Compare it with the southing constellations in this manual.

Principal stars have been selected for reference from among comparatively well known stars whose southing time roughly agrees with the dial reading.

Align the Polar Axis as Follows:

(1) Turn the polar axis turnbuckle and set the latitude dial approximately to the latitude of the point of observation. The turnbuckle is moved by inserting an accessory turning bar into the hole.

(2) Set the sidereal time dial to the local sidereal time estimated by the method mentioned above. Loosen the horizontal clamp of the mount and rotate the mount slowly on the horizontal plane until the polar axis is pointed at the Pole Star.

(3) Place your right eye to the eyepiece of the quick polar axis finder and look at the Pole Star with both eyes open. (In this way, the Pole Star is more easily sighted in the field.) When the Pole Star is caught, close your left eye and view through the center of the eyepiece with your right eye.

(4) Gently move the horizontal turning and polar axis turnbuckle until the Pole Star is in the center of the field. When the star enters the area of subdued brightness (about 1° in diameter) the star image grows much fainter. When the Pole Star is finally caught in the central transparent hole by careful maneuvering of the mount, it regains its former brightness. Adjustment of the polar axis is complete when the horizontal turning clamp is firmly tightened.

● It is also possible to mount PENTAX*100 on a pedestal and align the direction and altitude of the polar axis in several steps by using a motor drive and photographing the Pole Star. There are several handy references on telescopes to assist in doing this.

• The turnbuckle for adjusting the inclination of the polar axis can be used in the 20 to 50 degree range.

• If you set up the telescope in equatorial regions, an optional turnbuckle for latitudes 0° ~ 35° is necessary.

Proceed in the following manner if you use your PENTAX * 100 in the southern hemisphere:

(1) RA setting circle

The RA setting circle from 0h to 23h is read in the reverse direction in the southern hemisphere. In the northern hemisphere the figures on the RA setting circle increase when the telescope rotates on the polar axis to the east where stars rise, and the scale reading agrees with the right ascension of the star.

In the southern hemisphere, on the contrary, the RA scale reading decreases when the telescope rotates in an eastwardly direction around the polar axis and expresses only the hour angle.

(2) Motor unit

If you purchase the PENTAX motor unit, indicate that you wish to purchase the unit for use in the southern hemisphere (which turns in the reverse direction of that used for the northern hemisphere).

(3) Aligning the Polar Axis in the Southern Hemisphere

Since there is no star in the southern hemisphere corresponding to the Pole Star, the polar axis cannot be aligned with a quick polar axis finder. The polar axis is thus aligned in the following manner:

A. Point the polar axis as near as possible to the celestial south pole by using a compass. Stand the tripod firmly upright so that the mount is completely level.

B. Adjust the turnbuckle while watching the latitude scale of the mount until the reading coincides with your local latitude.

C. Pick out a bright star (A) near the zenith and find its equatorial coordinates in your star chart.

D. Assuming that the declination of star A is –35°30′, direct the telescope approx. at the zenith (the tube set to the west of the mount). Set the DEC setting circle to 35°30′ and tighten the DEC clamp.

E. Loosen the RA clamp, and move the tube in the RA direction while observing through the finder scope until star A is caught in the field of view.

F. Adjust so that star A aligns in the center of the RA direction in the finder scope field. Tighten the RA clamp.

G. Next adjust the deviation in the DEC direction slowly with the turnbuckle.

H. When the star is brought approximately to the center of the reticle in the finder scope, insert the standard eyepiece with the greatest magnification into the telescope. Then, turn the RA fine-tracking knob and the turnbuckle alternately until the star is brought to the center of the eyepiece field. Do not touch the DEC fine-tracking knob during this operation. (Deviation in the DEC direction should be corrected with the turnbuckle alone.) This completes altitude alignment of the polar axis.

I. After you have ascertained that star A is in the center of the eyepiece field and that the DEC setting circle reads – 35°30′, loosen the DEC and RA clamps, turn the telescope tube toward the southeastern sky and pick out another star (B) approx. 6 hours apart in right ascension from the star A near the zenith. Then bring star B to the center of the eyepiece field.

J. Check the DEC of star B with the star chart. If it is – 47°30′, while the DEC setting circle reads – 49°, the polar axis deviates by 1°30′ to the east from the true south. If the DEC setting circle reads – 47°, the polar axis deviates by 30′ to the west.

K. Assuming that the DEC setting circle reads –49° and, hence, eastwardly axis deviation amounts to 1°30′, turn the DEC fine-tracking knob until the DEC setting circle is set at –47°30′. Star B will naturally escape from the eyepiece field, so loosen the horizontal turning clamp of the mount and rotate the entire mount slowly to the west until star B is brought again into the field center of the eyepiece. Tighten the horizontal turning clamp of the mount.

- The above-mentioned alignment of the polar axis should be sufficient for ordinary observation purposes. If you are using your telescope to guide star-field photography which requires long exposure time, repeat the procedure from D through K several times till deviation is reduced to a minimum. Accurate alignment is facilitated appreciably by using an illuminated reticle eyepiece such as PENTAX-IRK-12.5 mm.
- If you desire to align the polar axis within an error factor of 2 or 3 minutes from the true south pole, you can also correct deviations of its direction and altitude by tracking stars over long hours with the motor drive system. Consult specialized references for details.

5. OBSERVATION

1. Preparations

It is thrilling to watch beautiful stars and famous nebulae through a telescope on a clear night. PENTAX *100 is a refracting telescope that features stabilized image formation and a big aperture (10 cm). It can satisfy almost all purposes of astronomical observation. However, good results are impossible to obtain if you use a telescope without preliminary knowledge of constellations.

The following items should be prepared:

(1) Planisphere: A sturdy one showing stars down to the 4th magnitude is preferable.

(2) Star charts: Norton's Star Atlas, Smithsonian Star Chart, etc.

(3) Ephemeris, astronomical almanac

In addition, books on constallations with photos and explanations, and beginner's manuals for the observation of planets are very useful aids for actual observation. Books on how to make telescopes are also helpful for understanding the optical system and mechanism of telescopes.

2. Objects and Optimum Magnifications

Knowledge of optimum magnifications for respective heavenly bodies is very handy. Some of them are listed in Table 3.

Table 3. **Objects of observation and magnifications**

Object of observation	Eyepiece and mag.	Remarks
Nebulae and clusters	K40 30X } (Optional) K30 40X } K25 48X	Easy to locate object because of bright and wide field. Very fine view.
Globular clusters and planetary nebulae	K25 48X K12.5 96X K9 133X	Somewhat higher mag. is used because of small size of objects.
Binaries	K25 48X } K12.5 96X } Or6 200X } Or5 240X }	Binaries of large angular distances. Color contrasts. Checking lens resolving power.
Variable stars	K25 48X K12.5 96X	Easy to compare with other stars because of wide field. Observation near limiting visual magnitude.
Seeking comets	K40 30X } (Optional) K30 40X }	Wide field with low magnification.
Guiding of star-field photography with mounted camera	IRK12.5 96X (Optional) K9 133X Or6 200X	The guide star is followed at high mag.
Moon	K25 48X K12.5 96X K9 133X Or6 200X	Occultation (entire moon surface visible). Sketching moon craters and other features.
Mars, Jupiter, Saturn	K12.5 96X K9 133X Or6 200X } Or5 240X }	Satellites, rings Details of surface features.
Mercury, Venus	K25 48X K12.5 96X } K9 133X } Or6 200X	Locating Venus in the daytime. Observing planets in phases When apparent diameter is small.
Sun	K25 } K20 (Optional) } K25 48X K12.5 96X } K9 133X }	With sun screen. Sun spots } With sun prism or sun glass. Detailed features }
Terrestrial landscapes	K30 40X (Optional) K25 48X } K12.5 96X }	Bright, though inverted image. Bright field with low mag. is preferable (with erecting prism).

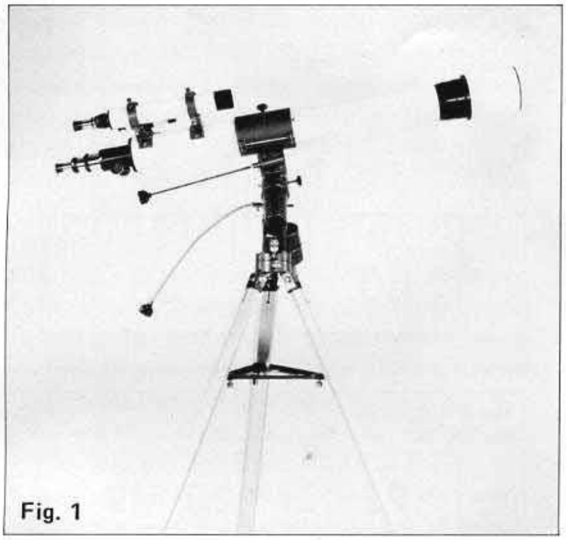


Fig. 1

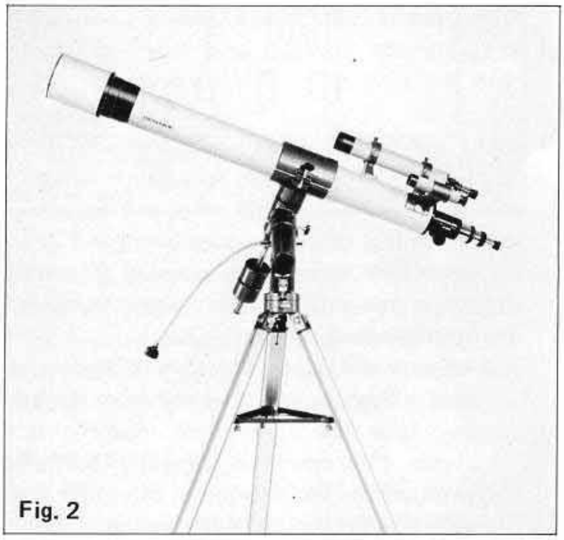


Fig. 2

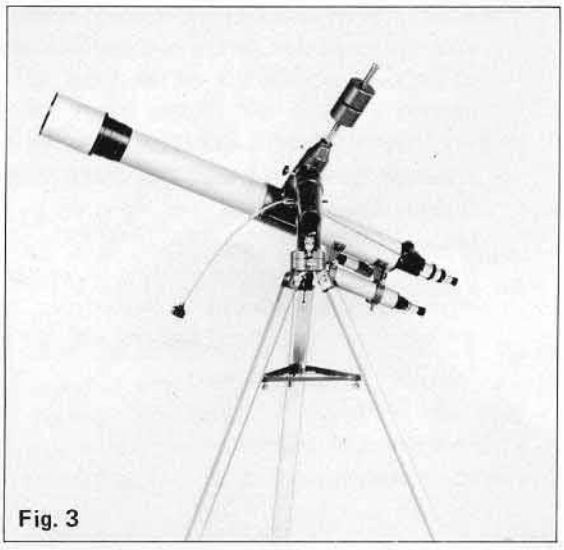


Fig. 3

3. How to Sight the Object

(1) Fit the K-25 eyepiece in place. Be sure to remove the cap.

(2) When you have picked out an object for observation, loosen the clamps of right ascension and declination. (Do not mistakenly loosen the mount clamp which was tightened after aligning the polar-axis.)

(3) Set the telescope as indicated in Fig. 1 if you want to observe objects to the east of the meridian, or rising stars, and set it according to Fig. 2 if you want to observe objects to the west of the meridian, or setting stars. If the eyepiece is too high for comfortable observation, as happens when you observe outer space near the horizon, it is possible to invert the RA and DEC axis 180 degrees by arranging them as shown in Fig. 3 so that the balance weights are positioned upwards.

(4) When the telescope is roughly pointed at the object, view it through the finder scope. The field of view of the finder scope measures about $7^{\circ}10'$ across, which is roughly the equivalent of 14 full moon diameters.

(5) If the direction of the telescope deviates from that of the object by more than 4 degrees, the object will not come into the field of the finder scope. With this fact in mind, place your eye level with the telescope tube and aim at the object. (Aiming will be nearly perfect if you aim along the top and the side of the barrel of the tube.) Then, look into the finder scope. The object should be in the field.

(6) After you have sighted the object in the finder scope, tighten the RA and DEC clamps. Turn the fine-tracking knobs of the RA and DEC axes until the object is brought into the field center of the finder scope.

(7)●Then, peep into the eyepiece of the main telescope and bring the object into focus by turning the focusing knob.

The star under observation will constantly move westwards through its diurnal motion. Therefore, it will be lost from view before long. In order to retain your object in the center of the field, you must slowly turn the RA fine-tracking knob to compensate for the diurnal motion.

●If the object is a very faint heavenly body invisible to the naked eye, it will be difficult to locate it with the aid of a finder scope alone. This observation is greatly simplified by the use of the RA and DEC setting circles.

The method for locating a faint object by using a star chart in conjunction with setting circles is explained briefly below.

Object of observation

M27 Dumbbell Nebula in Vulpecula
Magnitude: 7.6
RA: 19h 57.4m
DEC: +22°35′

M27 of Vulpecula is too faint to be visible with the naked eye. The following procedures must be taken to catch this nebula in the field of your telescope.

(1) Find the position of α Cygni (Deneb) with a star chart:
α Cygni RA: 20h 40m 33s
DEC: +45°11′19″
(This star has been chosen as the reference star.)

(2) Confirm the position of α Cygni with the naked eye and decide on which side of the polar axis the telescope tube should be set.

(3) Loosen the DEC clamp and set 44° (approx.) of the setting circle to DEC index 0. Tighten the DEC clamp.

(4) Turn the DEC fine-tracking knob while watching the vernier of the DEC setting circle until the scale comes to the position shown in Fig. 1. Now the declination is set at approx. 45°15′.

(5) Next, loosen the clamp of the RA index, turn the O-index to an easily readable position and tighten the clamp lightly.

(6) Loosen the RA clamp and rotate the telescope tube in the direction of α Cygni. Tighten the RA clamp and turn the tube gently with the RA fine-tracking knob until α Cygni is in the finder scope.

(7) After bringing α Cygni into the precise center of the reticle, look through the main telescope with the K-25 eyepiece. Bring the star to the center of the RA segment by manipulating the RA fine-tracking knob. Also use the DEC fine-tracking knob if there is deviation in the DEC direction.

(8) After the star has been brought to the center of the eyepiece field, loosen the clamp of the RA setting circle and turn it with your fingers until 20 h 40m is matched against the O-index. (The last figure here has been rounded off.)

Fig. 1

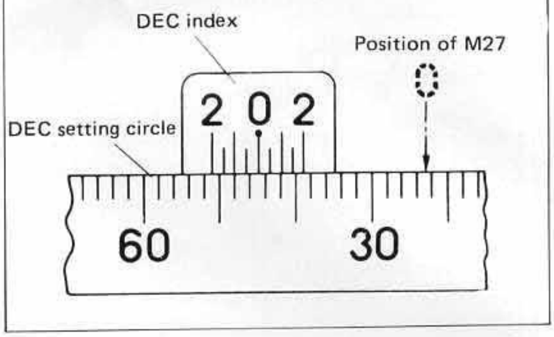
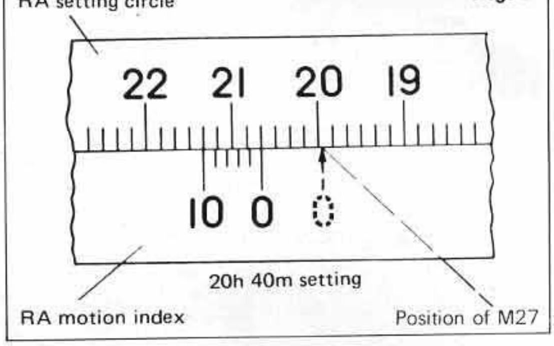


Fig. 2



(9) Reconfirm to see if α Cygni is at the center of the eyepiece field after the setting circle has been adjusted.
- As stars are incessantly moving from east to west α Cygni will move away from the field if you take too much time adjusting setting circles. This operation is greatly facilitated if you use the optional motor drive unit when adjusting the setting circles.
- After this adjustment, the setting circles of your telescope will correspond to right ascensions and declinations of all stars in the heavens.

(10) You are now in a position to point the telescope directly at M27 Dumbbell Nebula. Quickly loosen the RA clamp and set an RA reading of 19h 57.4m (RA of M27) against the O-index. The vernier reading may be 58m after rounding. When using the vernier, turn the tube with your hand and not with the RA fine-tracking knob.

(11) Then loosen the DEC clamp and set the declination at +22°35' (vernier reading, +22°30'). The unique Dumbbell Nebula should be looming in the eyepiece field. Bring it to the center of the field by manipulating the fine-tracking knobs. If necessary, change the eyepiece to K12.5 (96X), etc., for more detailed observation.

- At first sight it seems to be easy to locate any object successfully by the above-mentioned method. But errors tend to accumulate owing to the diurnal motion of stars, unless one is very adept at continuously turning the RA fine-tracking knob. Use of the motor unit eliminates this chore and source of error.
- The reference star should not be far away from the object under observation. A bright star with known coordinates, which are as close as possible to those of the object of observation, should be selected as the reference star.
- The motion of the tube can be matched to the diurnal motion of the heavens (23 hours 56 minutes 4 seconds per revolution) by turning the RA fine-tracking knob at a rate of once every 8 minutes 30 seconds. Again for accurate tracking of stars, however, as well as for astrophotography and sketching, this operation becomes comparatively simple with the optional motor drive system.

4. Observing the Sun

The sun can be easily observed in broad daylight. However, certain safety rules must be followed to protect your vision and avoid damaging the telescope.

The sun is about 430,000 times brighter than the full moon and its rays generate intense heat and light. Never look at the sun directly through a telescope eyepiece: **This could blind you.**

5. Using Sunglass

(1) To observe the sun directly, remove the cap of the eyepiece and screw in the accessory sun glass.

(2) Next, place the objective lens cap over the objective lens and remove the inner section marked "PENTAX." This reduces the aperture of the telescope from 10 cm to 5 cm. Do not fail to use the lens cap to reduce aperture size when employing the sunglass, as viewing with the original 10 cm aperture could break the sunglass. Use the sun prism for observation at full aperture.

(3) When the above preliminaries are completed, point the telescope at the sun; place a sheet of white paper some 30 cm from the finder eyepiece. Without looking into the eyepiece, bring the image of the sun projected on the paper and the reticle into focus by turning the eyepiece.

(4) Turn the fine-traking knobs until the sun is at the center of the reticle. When you now look through the sun glass of the main telescope, you should see the sun at the center of the field. Place the cap over the finder scope after the sun is aligned.

6. Observation with Sun Screen

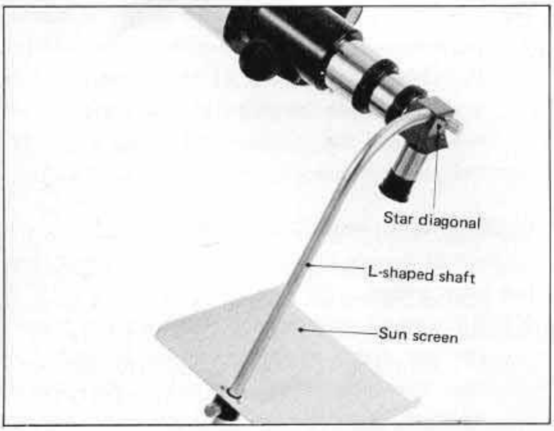
Several people can view the sun together if you use a sun screen.

(1) Fit a standard eyepiece (without sun glass) to the star diagonal and insert the assembly into the telescope after removing the eyepiece adapter from the telescope. Clamp in place with the eyepiece turned downwards.

(2) Insert the straight end of the L-shaped shaft to the mounting hole of the sun screen and clamp lightly in place. The rim on the edges of the sun screen serves to cut off unnecessary sun rays.
Make sure the edges are turned up toward the telescope as shown in the illustration.

(3) After mounting the sun screen to the shaft, insert the other end of the shaft into the mounting hole of the star diagonal. Next loosen the clamp screw on the star diagonal and insert the shaft as far as it will go. Align the screen for projection with the eyepiece and tighten the clamp screw.

• K-25 or the optional K-20 are preferable as the projecting eyepieces. An eyepiece with high magnification reduces the luminosity of the sun's image and makes observation difficult. Use of a stop at the objective (5 cm aperture) is safer for a prolonged observation. Mount the sun screen after the telescope is pointed approximately at the sun, as the tripod may interfere with the sun screen if the tube is adjusted after mounting.



6. ASTROPHOTOGRAPHY

1. Direct Focus Photography

This telescope can be used as a 1,200mm F12 ultra telephoto lens for photographing heavenly bodies and terrestrial landscapes. A 35 mm single-lens reflex camera with a mount for interchangeable lenses is most suitable for this purpose.

The camera mounts to the telescope via a separately sold camera adapter. A PENTAX screw-mount adapter, a bayonet-mount adapter and adapters for other cameras (Nikon, Minolta, Canon and Olympus) are available. Generally speaking, the moon is the most interesting heavenly body for photographing with a 1,200mm lens and renders the most detail.

The image of the moon on the film varies with the distance between the earth and the moon, the mean distance being 384,418 km. At this distance, the moon focuses on the film surface as a disk 10.9 mm in diameter. Shutter speed must also be varied in accordance with the phase of the moon and the clearness of the sky.

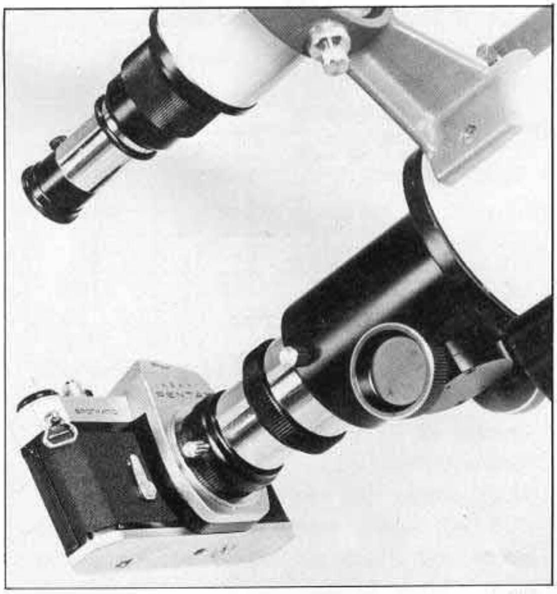
Optimum shutter speeds with ASA 100 film would be:

1/125 sec. for a full moon,
1/60 sec. for a half moon,
1/15 – 1/4 sec. for a crescent moon

A cable release is recommended for easy shutter release with minimum movement.

Fine-grained film produces the best results for moon photography, as high enlargement of the picture will be required. Do not use the slow shutter speed indicated for low-sensitivity, fine-grained film, however, unless a motor drive unit is used. This is because the image will become distorted owing to diurnal motion at a slow shutter speed without accurate tracking. If, for example, we shoot a crescent at a shutter speed of 1 sec., small craters will appear blurred since the moon is traveling at a speed of 15" per second. On the other hand, needle sharp pictures of the moon can be obtained even at slow shutter speeds by employing the optional motor drive unit and setting the tracking speed to MOON.

Photographing of terrestrial landscapes is also possible with this telescope by adjusting the shutter speed to match an aperture of F12. An optimum exposure is immediately obtained if you use cameras with automatic or semi-automatic exposure control. With cameras not having exposure controls use an exposure meter if necessary as exposure will vary based on weather conditions and other factors.



2. Photography with the Eyepiece Magnifier

The approximate focal length of the objective may be extended by using the optional eyepiece magnifier. This device is extremely valuable in photographing planets and the moon. Magnifications with the magnifier are as follows:

Table 4.

Eyepiece	Approx. focal length	Magnification	Brightness
K-25	2,800 mm	2.33 X	F28
K-12.5	6,400 mm	5.33 X	F64
K-9	9,700 mm	8.1 X	F97
Or-6	15,400 mm	12.8 X	F154

A camera adapter is necessary when you use the eyepiece magnifier.

(1) Choose an eyepiece and insert it into the eyepiece sleeve.

(2) Then screw the eyepiece magnifier in the PENTAX screw mount at the base of the sleeve and attach the camera adapter to the camera body. Preparations are complete when this camera adapter has been inserted into the eyepiece magnifier.

(3) When the angle of the camera body has been fixed, clamp the eyepiece magnifier tightly in place to prevent the camera from dropping off. Photographing at long focal length tends to be affected by wind and vibration. Meticulous care is required in focusing and shutter operation. It may be sometimes convenient to use a building wall as a windbreak.

- Shutter speeds vary over a wide range depending upon how clear the sky is and the altitude of the object. A rule of thumb for choosing correct shutter speeds is listed below. These are only fixed values, however, and it would be best to compile your own exposure data for different heavenly bodies by testing various shutter speeds.

Table6. Suitable shutter speeds for various objects

Object	Shutter speed (sec.)			
	K25mm	K12.5mm	K9mm	Or6mm
Mercury	1/30	1/8 ~ 1/4	1/2	2 ~ 4
Venus	1/250	1/60 ~ 1/30	1/15	1/4 ~ 1/2
Mars	1/15	1/4 ~ 1/2	1	4 ~ 8
Jupiter	1/4	1 ~ 2	4	15 ~
Saturn	1.5	4 ~ 6	15	60 ~
Moon (half)	1/8	1/2 ~ 1	2	8

Table 5. Size of objects on film

Object	Position	Apparent diameter	Size on film (mm)			
			K 25mm	K 12.5mm	K 9mm	Or 6mm
Mercury	Greatest elongation	7 ~ 9"	0.09 ~ 0.12	0.22 ~ 0.28	0.33 ~ 0.42	0.52 ~ 0.67
Venus	Greatest elongation	24 ~ 30"	0.32 ~ 0.4	0.74 ~ 0.93	1.13 ~ 1.4	1.8 ~ 2.2
Mars	Opposition (average)	18"	0.24	0.56	0.85	1.35
Jupiter	Opposition	47"	0.63	1.45	2.2	3.5
Saturn	Opposition	19"	0.25	0.59	0.89	1.42
Moon	Mean distance	31'	1mm/139km 25φ	1mm/60km 57φ	1mm/40km 88φ	1mm/25km 140φ

3. Star-Field Photography

As star-field photography requires long exposure time, the film may be adversely affected if there is stray light nearby. Big cities are unsuitable for such photographing and the remote countryside on a clear night is best.

Mount the camera without detaching its lens. A fast lens shortens exposure time and promises better results. You had better lower the aperture by 1 or 2 steps in order to reduce marginal coma. Also, shorter exposure time is required and more favorable results are possible if high-speed films are used.

The camera is mounted to the telescope tube with an accessory camera holder unit (optional). The camera holder mounts to the telescope using a band and a clamp screw. When the camera is fixed at the front end of the tube, even a 24mm ultra wide-angle lens will take pictures without obstruction. 150-200mm telephoto lenses may also be used without obstruction by fixing the camera near the middle of the tube, the most suitable position in this instance.

Directly mounting the camera body to the camera holder offers the most stability, but has a disadvantage in that the camera cannot be pointed in an arbitrary direction. For the latter purpose, screw a sturdy tripod head into the camera holder and mount the camera on it. When this is done, the equilibrium of the telescope must be readjusted by moving balance weights.

The major enemy of star-field photography is night dew. Often the surface of metal equipment will drip with dew. If the lens fogs, all efforts are futile. To counter this, you may devise a long lenshood of cardboard or plastic. Design it in a manner so that it doesn't interfere with the picture area and paint the interior of the hood black to prevent reflections. In this way, it not only guards against dew but also city lights.

Tracking of stars over a short period of time may be possible with the RA fine-tracking knob alone. But prolonged tracking is greatly facilitated by using the motor drive unit and the optional illuminated reticle eyepiece with a built-in LED. The picture angles and limiting magnitudes of the SMC PENTAX series of interchangeable lenses are listed below:

Table 7. Picture angles and limiting magnitudes

Focal length of lens (mm)	F-number	Picture angles (L x W)	Limiting magnitude (For ASA 100 & 30 m. ex.)
24	3.5	53° x 74°	7.3
28	3.5	46° x 65°	7.6
35	2	38° x 54°	9.3
50	1.4	27° x 40°	10.9
55	1.8	24° x 36°	10.6
85	1.8	16° x 24°	11.5
105	2.8	13° x 19°	11.0
120	2.8	11.4° x 17°	11.3
135	2.5	10° x 15°	11.8
150	4	9° x 13.7°	11.0
200	4	6.9° x 10.3°	11.6
300	4	4.6° x 6.9°	12.5

7. STORAGE AND MAINTENANCE

- Pack the telescope tube in the case when not in use along with eyepieces and the sun glass in the proper places.
- The equatorial mount and tripod can be left standing as assembled to avoid dismantling and reassembly. The aluminum legs are rust proof; however, the mount should be enclosed in its waterproof cover.
- Do not leave fingerprints and smears on the surfaces of the objective and eyepieces, especially when stored for a long period of time. Wipe such stains away periodically with clean cotton cloth or gauze soaked in alcohol.

8. HANDLING PRECAUTIONS

1. Objective

The objective lens is the life of an astronomical telescope.

The optical axis will be knocked out of line by hard shocks on the frame and the hood of the objective lens. Leaving flaws or stains on the objective lens surface can cause flare. Take care not to touch the lens surface with your finger.

The objective lens frame has 3 sets of optical axis adjusting screws. The telescope is supplied with its optical axis perfectly aligned. If you inadvertently move the screws and alter the optical axis, it must be properly readjusted.

The optical axis is realigned as follows:

(1) Loosen the objective lenshood and detach it from the tube.

(2) Have a screwdriver ready which fits the adjusting screws.

(3) Insert a centering eyepiece, if one is available, into the eyepiece sleeve. If not, loosen the clamp and remove eyepiece sleeve for easier observation.

(4) Put the cap on the detached hood and lightly screw it back into the objective lens frame (about 1 to 2 turns).

(5) Peep into the eyepiece end of the tube using a lighting source to reflect the image of your eye on the other end of the tube. (At night, hold a bright flashlight or lantern at your side for sufficient illumination).

(6) Reflected on the hole on the objective lens will be one large and one small circle with your eye near the center of the circles. When the optical axis is properly aligned, the two circles will be perfectly concentric and your eye will be at their exact center.

- If the circles are eccentric, shift your eye to the right and the left as far as the hole diameter (which is 38ϕ) permits. If the circles become concentric when you shift your eye to the left, the left hand side of the objective frame (as seen from the eyepiece side) has too wide a gap. Loosen and tighten the appropriate adjustor screws to offset this.
- The hood must be screwed in (1 or 2 turns) each time the screws are adjusted, which is somewhat troublesome. However, the hood can be dispensed with by doing this at night with the telescope directed toward the darkness.

(7) After concentric circles have been established, tighten the 3 pairs of screws with the same force and make a final check. Adjustment is now complete.

(8) Screw in the hood.

2. Eyepieces

Dirt on eyepiece lenses causes flare and hampers observation of detailed features of the moon and planets. The eye lens of an eyepiece can be smeared through contact with eyelashes. Remove the screwed cap and clean with alcohol. The field lens of an eyepiece is less liable to smear, but dust may accumulate on it and spoil a good view. Blow away dust with a blower. It is difficult to clean this lens with alcohol; take care not to touch it with your fingers.

3. Other Precautions

Avoid smudging the glass surface of all optical instruments, including the star diagonal. Prevent sand and dirt from getting into the rack and pinion gear of the focusing mechanism. (This will damage the gearing and make critical focusing impossible.) Do not force-turn the telescope tube when the RA and DEC mounting axes are tightly set. Loosen clamps before moving the tube.

9. OPTIONAL ACCESSORIES

1. Eyepieces

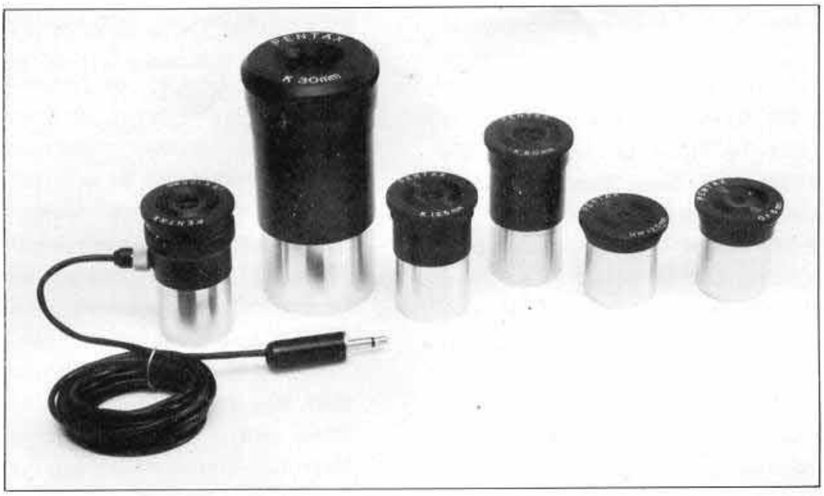
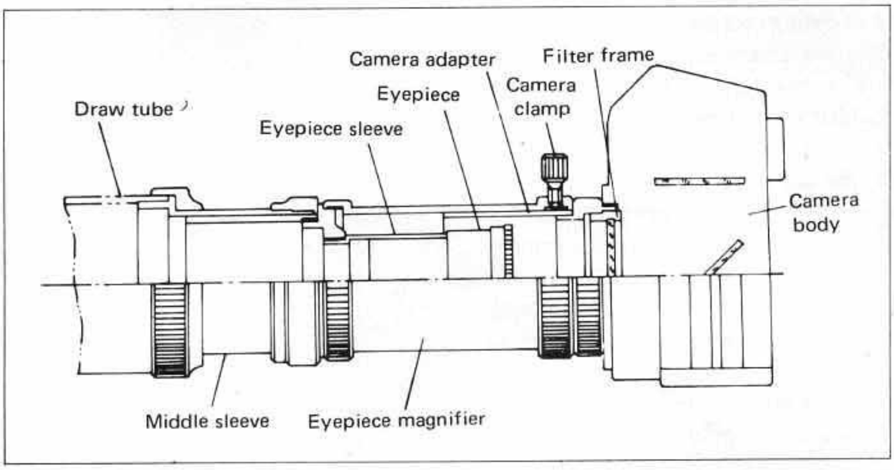


Table 8.

Type	Lens elements	· Focal length	Magnification	Magnification per cm of aperture	Real field of view	Eye ring diameter
Mittenzwey-Huygens	2	12.5mm	96x	9.6x	28′	1mm
Mittenzwey-Huygens	2	20mm	60x	6x	45′	1.7mm
Kellner	3	20mm	60x	6x	45′	1.7mm
Mittenzwey-Huygens	2	25mm	48x	4.8x	58′	2.1mm
Kellner	3	30mm	40x	4x	1° 08′	2.5mm
Kellner	3	40mm	30x	3x	1° 30′	3.3mm

2. Camera adapters

PENTAX Takumar screw-mount type, bayonet K-mount. Also, adapters for other brand 35 mm single-lens reflex cameras (Nikon, Minolta, Olympus and Canon).



3. **Eyepiece magnifier**

This is used in conjunction with a camera adapter and attaches to the telescope with a screw in the eyepiece holder. A camera adapter is needed. The K-25 or K-12.5 eyepieces are best suited for use with this adapter.

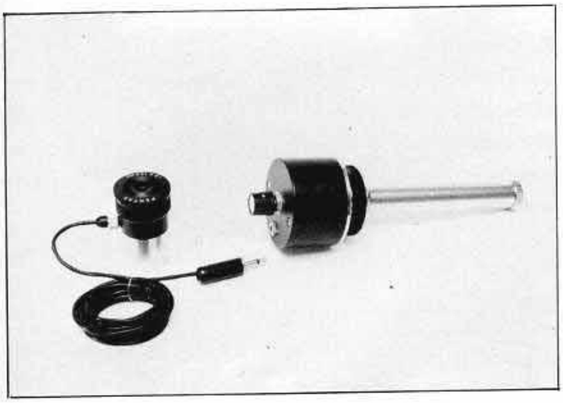
The Or-6 may also be used, however, if you are exceptionally careful in focusing and keeping vibration low.

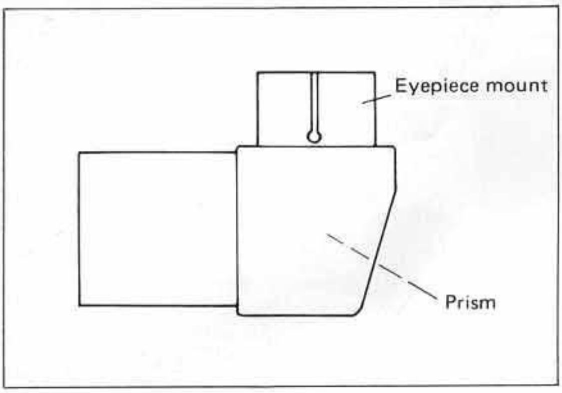
4. **Illuminated reticle eyepiece (with power source)**

This eyepiece aids the guiding of astronomical photography. The built-in light emitting diode illuminates in red light the reticle in the eyepiece field, facilitating the exact bringing of a star to the center of the eyepiece field.

The standard reticle eyepiece of the guiding scope for PENTAX·100 can be converted into an illuminated reticle eyepiece by adding the separately sold power source and cord.

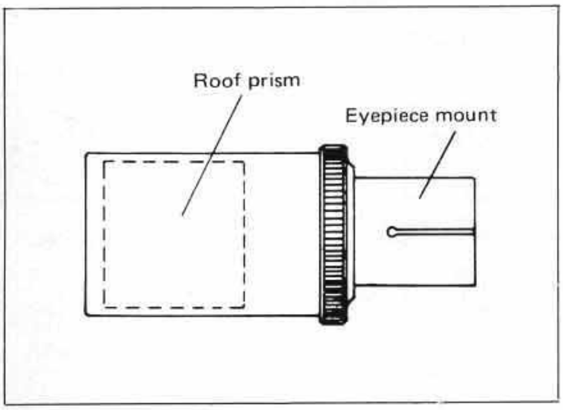
Specifications:
A. Eyepiece
Type: Kellner
Lens elements: 3
Focal length: 12.5 mm
Apparent field of view: 45°
B. Power source
Battery: 2 "AA" cells
Power supply cord





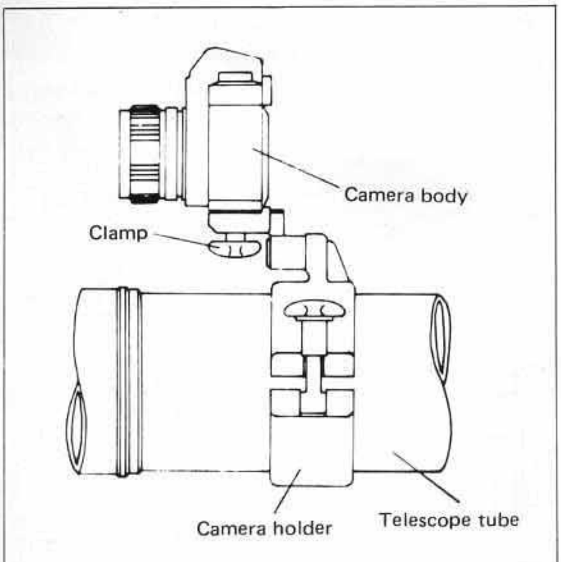
5. Sun prism

The sun prism is a very convenient accessory for solar observation over a long period of time. Most of the light and heat of the sun are deflected by the prism, and only 5 per cent enters into the eyepiece. A sun glass must be attached to the eyepiece without fail when the sun prism is used.



6. Erecting prism

This prism corrects the image when using the telescope for observing terrestrial landscapes. A roof prism is incorporated.



7. Camera holder

The camera holder is clamped around the telescope tube to mount the camera for star-field photographing. Used in conjunction with a commercially available tripod head, the holder permits rotating the camera freely.

8. Motor drive system

(1) Motor unit

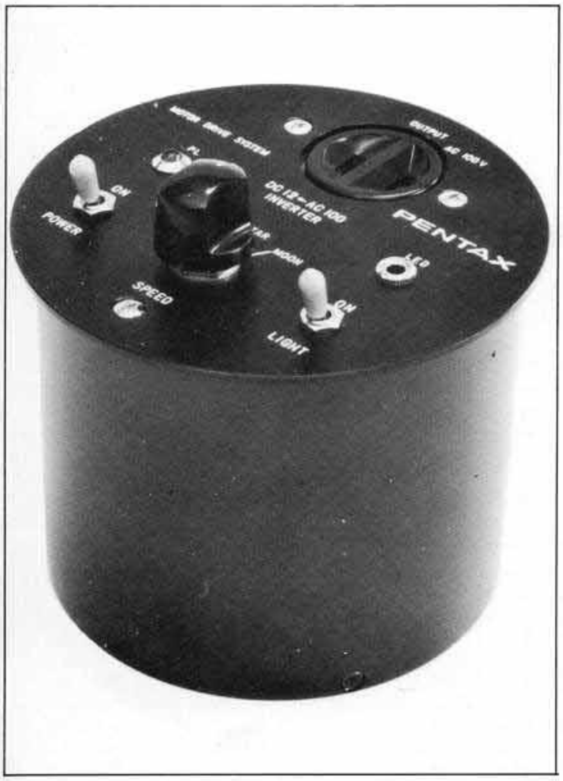
Incorporates AC 100V 50 Hz, 60 Hz synchronized motor, with a 2 m AC cord.

Preadjusted to the diurnal motion of the stars. (Error margin is a mere 1 sec. per tracking hour.)

(2) Quartz oscillator motor drive unit

Incorporates 3 oscillating speeds – STAR, SUN and MOON – for accurate tracking of each. Operates on DC 12 V power source; AC 100 V output.

When used outdoors, the unit connects to the cigar lighter socket of a car with an accessory cord for powering from a car battery.



9. Other Accessories

An Apochromat triplet objective is also available.

10. REFERENCE MATERIALS

Equatorial coordinates of principal fixed stars

Table 9. (Stars brighter than magnitude 3.0, were at the northern side of −60° Dec., as of 1974. 5)

Name of star	Magnitude	R. A. α		Dec. δ		Name of star	Magnitude	R.A. α		Dec. δ	
α And	2.2	0h	07 m	+28°	57′	κ Ori	2.2	5h	47 m	− 9°	41′
β Cas	2.4		08	+59	00	α Ori	0.1~1.2		54	+ 7	24
γ Peg	2.9		12	+15	02	β Aur	2.1		58	+44	57
α Phe	2.4		25	−42	27	β CMa	2.0	6	22	−17	57
α Cas	2.5		39	+56	24	α Car	−0.9		23	−52	41
β Cet	2.2		42	−18	8	γ Gem	1.9		36	+16	25
γ Cas	2.8		55	+60	35	α CMa	−1.6		44	−16	41
β And	2.4	1	08	+35	29	τ Pup	2.8	6	49	−50	35
δ Cas	2.8		24	+60	06	ε CMa	1.6		58	−28	56
α Eri	0.6		37	−57	22	δ CMa	2.0	7	07	−26	21
β Ari	2.7		53	+20	41	π Pup	2.7		16	−37	03
γ And	2.3	2	02	+42	12	η CMa	2.4		23	−29	15
α Ari	2.2		06	+23	21	α Gem	1.6		33	+31	57
α UMi	2.1		07	+89	09	α CMi	0.5		38	+ 5	17
α Cet	2.8	3	01	+ 3	59	β Gem	1.2		44	+28	05
β Per	2.2~3.5		06	+40	51	ζ Pup	2.3	8	03	−39	56
α Per	1.9		22	+49	46	ρ Pup	2.9		06	−24	14
ζ Per	2.9		52	+31	49	γ Vel	1.9		09	−47	16
ε Per	3.0		56	+39	56	ε Car	1.7		22	−59	26
α Tau	1.1	4	34	+16	28	λ Vel	2.2	9	07	−43	20
ι Aur	2.9		55	+33	08	ι Car	2.3		16	−59	10
β Eri	2.9	5	07	− 5	07	κ Vel	2.6		21	−54	54
β Ori	0.3		13	− 8	14	α Hya	2.2		26	− 8	33
α Aur	0.2		15	+45	58	α Leo	1.3	10	07	+12	06
γ Ori	1.7		24	+ 6	20	β UMa	2.4	11	00	+56	31
β Tau	1.8		25	+28	35	α UMa	2.0		02	+61	53
α Lep	3.0		27	−20	47	δ Leo	2.6		13	+20	40
ε Ori	1.8		35	− 1	13	β Leo	2.2		48	+14	43
ζ Tau	3.0		36	+21	08	γ UMa	2.5		52	+53	50
α Col	2.8		39	−34	05	δ Cen	2.9	12	07	−50	35

Name of star	Magnitude	R.A. α		Dec. δ		Name of star	Magnitude	R.A. α		Dec. δ	
γ Crv	2.8	12 h	14 m	−17°	24′	ε Sco	2.4	16 h	49 m	−34°	15
γ Cru	1.6		30	−56	58	β Ara	2.8	17	23	−55	30
β Crv	2.8		33	−23	15	υ Sco	2.8		29	−37	17
β Cru	1.5		46	−59	33	β Dra	3.0		30	+52	19
ε UMa	1.7		53	+56	06	α Ara	3.0		30	−49	51
α CVn	2.9		55	+38	27	λ Sco	1.7		32	−37	05
ε Vir	3.0	13	01	+11	06	α Oph	2.1		34	+12	35
ι Cen	2.9		19	−36	35	θ Sco	2.0		35	−42	59
ζ UMa	2.4		23	+55	03	κ Sco	2.5		41	−39	01
ε Cen	2.6		38	−53	20	β Oph	2.9		42	+ 4	35
η UMa	1.9		47	+49	26	γ Dra	2.4		56	+51	29
η Boo	2.8		53	+18	31	δ Sgr	2.8	18	19	−29	50
θ Cen	2.3	14	05	−36	15	ε Sgr	2.0		22	−34	24
α Boo	0.2		14	+19	19	λ Sgr	2.9		26	−25	26
γ Boo	3.0	14	31	+38	25	α Lyr	0.1		36	+38	46
η Cen	2.7		34	−42	03	σ Sgr	2.1		54	−26	20
α Lup	2.9		40	−47	17	γ Aql	2.8	19	45	+10	33
α2 Lib	2.9		49	−15	56	α Aql	0.9		50	+ 8	48
β UMa	2.2		51	+74	16	γ Cyg	2.3	20	21	+40	10
β Lup	2.8		57	−43	02	α Pav	2.1		24	−56	49
β Lib	2.7	15	16	− 9	17	α Cyg	1.3		41	+45	11
α CrB	2.3		34	+26	48	ε Cyg	2.6		45	+33	52
α Ser	2.8		43	+ 6	30	α Cep	2.6	21	18	+62	29
δ Sco	2.5		59	−22	33	ε Peg	2.5		43	+ 9	45
β Sco	2.9	16	04	−19	44	δ Cap	3.0		46	−16	15
δ Oph	3.0		13	− 3	38	α Gru	2.2	22	07	−47	05
α Sco	1.2		28	−26	23	β Gru	2.2		41	−47	01
β Her	2.8		29	+21	33	α PsA	1.3		56	−29	45
τ Sco	2.9		34	−28	10	β Peg	2.6	23	03	+27	57
ζ Oph	2.7		36	−10	31	α Peg	2.6		03	+15	04

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