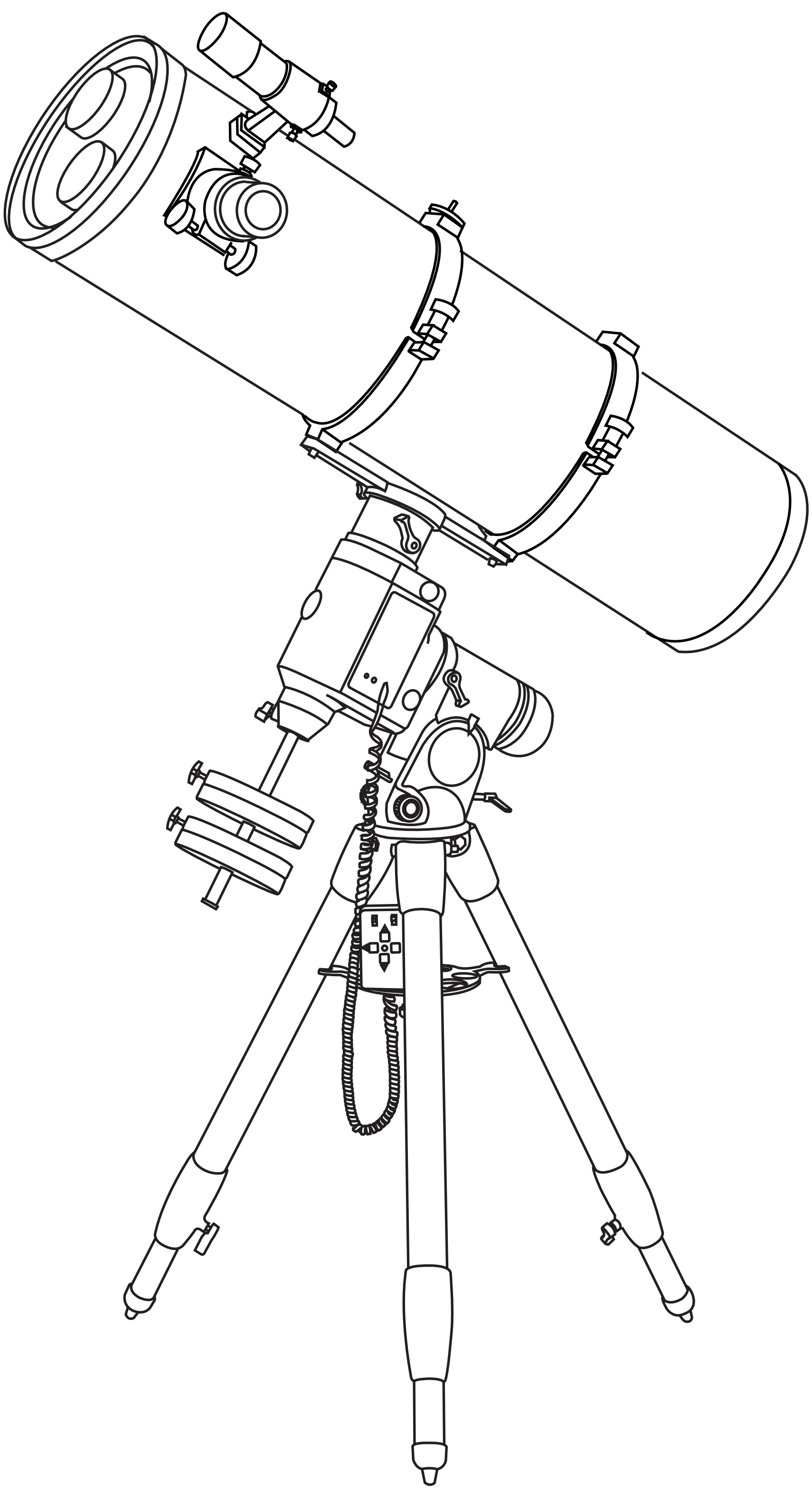
INSTRUCTION MANUAL

SK P25012EQ6-2IN



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Before you begin

Read the entire instructions carefully before beginning. Your telescope should be assembled during daylight hours. Choose a large, open area to work to allow room for all parts to be unpacked.

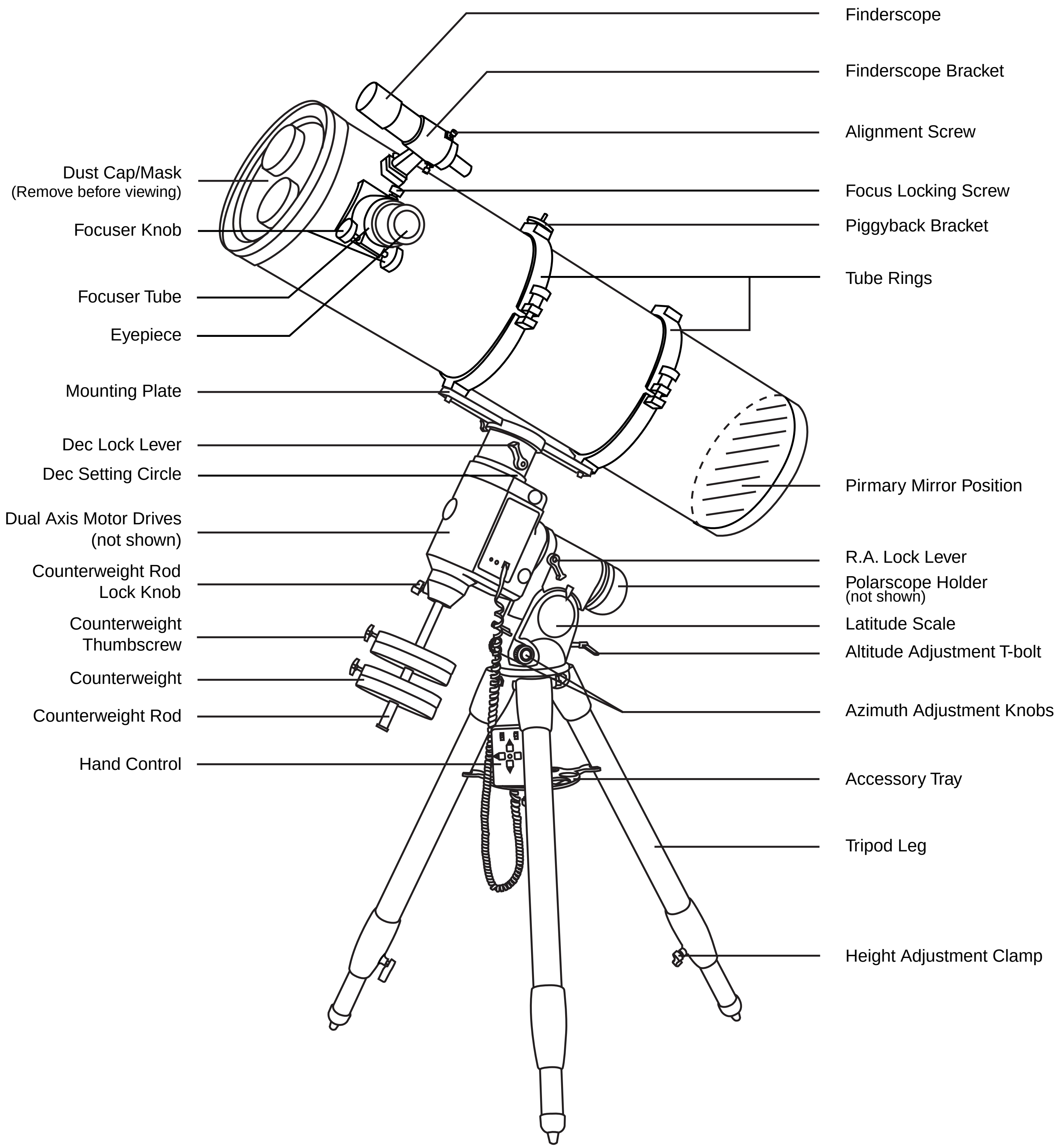
Technical Support

Please contact your dealer for technical support.

Caution!

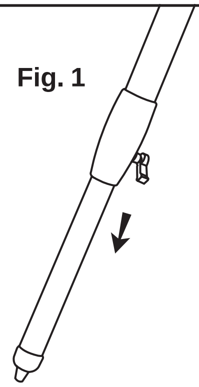
NEVER USE YOUR TELESCOPE TO LOOK DIRECTLY AT THE SUN. PERMANENT EYE DAMAGE WILL RESULT. USE A PROPER SOLAR FILTER FOR VIEWING THE SUN. WHEN OBSERVING THE SUN, PLACE A DUST CAP OVER YOUR FINDERSCOPE TO PROTECT IT FROM EXPOSURE. NEVER USE AN EYEPIECE-TYPE SOLAR FILTER AND NEVER USE YOUR TELESCOPE TO PROJECT SUNLIGHT ONTO ANOTHER SURFACE, THE INTERNAL HEAT BUILD-UP WILL DAMAGE THE TELESCOPE OPTICAL ELEMENTS.

THE SK P25012EQ6-2IN



TRIPOD SET UP

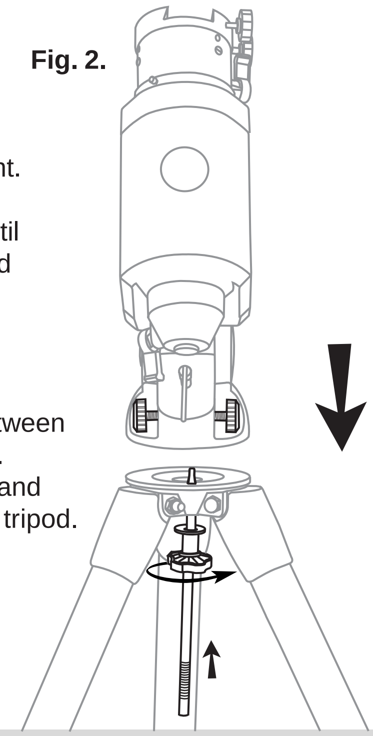
Fig. 1



ASSEMBLING THE TRIPOD LEGS (Fig.1)

1) Slowly loosen the height adjustment clamp and gently pull out the lower section of each tripod leg. Tighten the clamps to hold the legs in place.
2) Spread the tripod legs apart to stand the tripod upright.
3) Place a carpenter's level or bubble level on the top of the tripod legs. Adjust the height of each tripod leg until the tripod head is properly leveled. Note that the tripod legs may not be at same length when the equatorial mount is level.

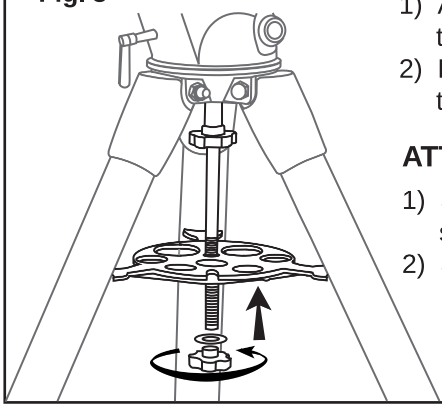
Fig. 2.



ATTACHING MOUNT TO TRIPOD LEGS (Fig. 2)

1) Align metal dowel on the tripod head with the gap between the azimuth adjustment knobs underneath the mount.
2) Push the primary locking shaft up against the mount and turn the knurled knob underneath to secure mount to tripod.

Fig. 3



ATTACHING THE ACCESSORY TRAY (Fig. 3)

1) Slide the accessory tray along the primary locking shaft until it pushes against the tripod legs.
2) Secure with the washer and locking knob.

Note: Loosen the azimuth adjustment knobs if mount does not fit into tripod head completely. Retighten knobs to secure.

MOUNT ASSEMBLY

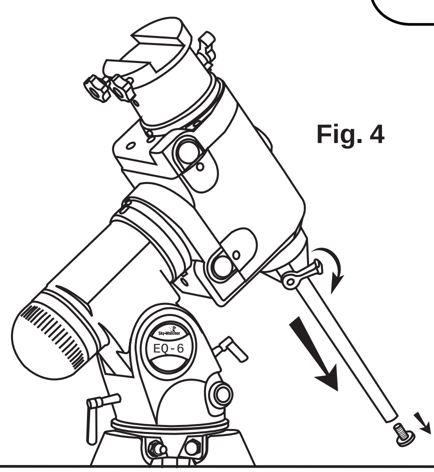
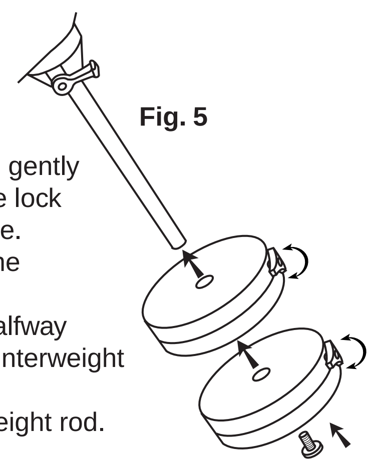


Fig. 4

INSTALLING THE COUNTER-WEIGHTS (Fig. 4, 5)

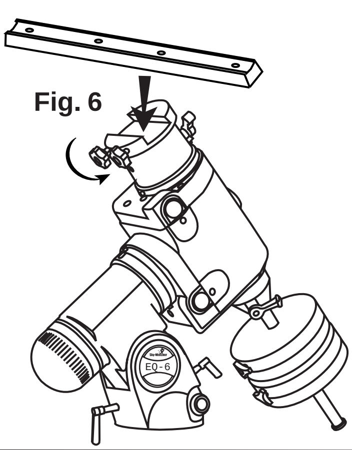
1) Loosen the counterweight rod lock knob and gently pull out the counterweight rod. Re-tighten the lock knob to secure the counterweight rod in place.
2) Unscrew the threaded cap from the end of the counterweight rod.
3) Locate the counterweights and slide them halfway along the counterweight rod. Tighten the counterweight thumb screws to secure.
5) Replace the cap on the end of the counterweight rod.

Fig. 5



TELESCOPE ASSEMBLY

Fig. 6



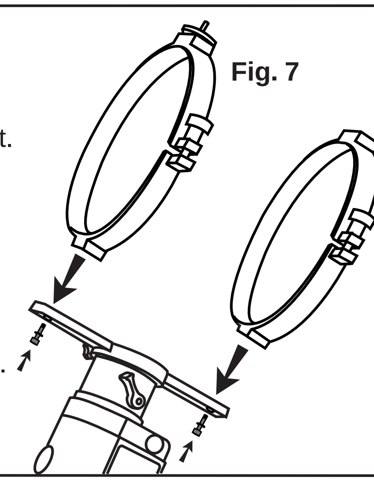
ATTACHING THE MOUNTING PLATE (Fig.6)

1) Position the mounting plate on the mounting bracket.
2) Secure by tightening the two locking screws.

ATTACHING THE TUBE RINGS (Fig.7)

1) Remove the telescope tube assembly from its plastic packaging.
2) Remove the tube rings from the telescope by releasing their thumb nuts and opening their hinges.
3) Using the bolts provided, fasten the tube rings to the mount with the 10mm wench provided.

Fig. 7



TELESCOPE ASSEMBLY

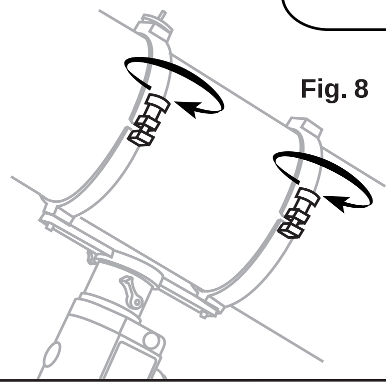


Fig. 8

ATTACHING THE TELESCOPE MAIN TUBE TO THE TUBE RINGS (Fig.8)

1) Remove the telescope tube from the paper covering.
2) Find the center of balance of the telescope tube. Place this in between the two tube rings. Close the hinges around the telescope and fasten securely by tightening the thumb nuts.

FINDERSCOPE ASSEMBLY

Fig.9

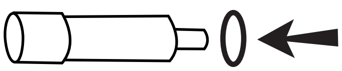
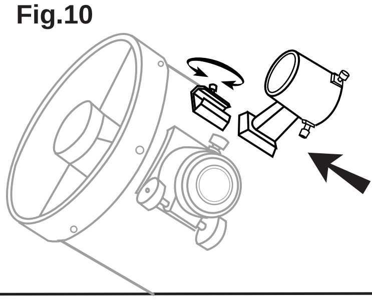


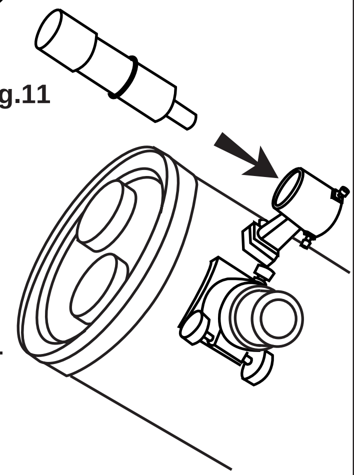
Fig.10



ATTACHING THE FINDERSCOPE BRACKET (Fig. 9,10,11)

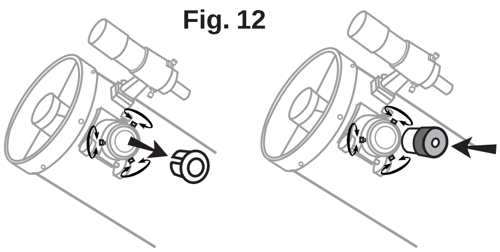
1) Locate the finderscope bracket. Carefully remove the rubber-o-ring from the finderscope bracket.
2) Position the o-ring into the groove located approximately half-way along the finderscope tube.
3) Locate the finderscope optical assembly.
4) Slide the finderscope bracket into the rectancular slot and tighten the screw to hold the mount in place.
5) Position the finderscope into its bracket by sliding it backwards until the rubber o-ring seats in the finderscope mount.

Fig.11



EYEPIECE ASSEMBLY

Fig. 12



INSERTING EYEPIECE (Fig. 12)

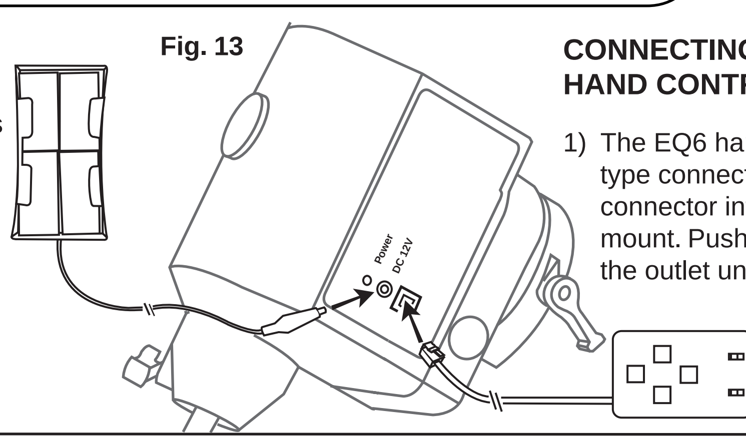
1) Unscrew the thumbscrews on the end of the focus tube to remove the black plastic end-cap.
2) Re-tighten thumb screws to hold the eyepiece in place.

HAND CONTROL INSTALLATION

POWERING THE EQ6 MOTORS (Fig. 13)

1) Insert eight "D" cell batteries into the battery case.
2) Plug the DC power cord from battery case into the DC 12V outlet on the side of the mount.

Fig. 13

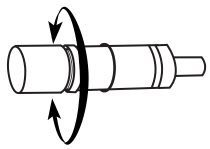


CONNECTING THE HAND CONTROL (Fig. 13)

1) The EQ6 hand control has a phone type connector. Plug the phone jack connector into the outlet on the mount. Push the connector into the outlet until it clicks into place.

Aligning the finderscope

Fig.a



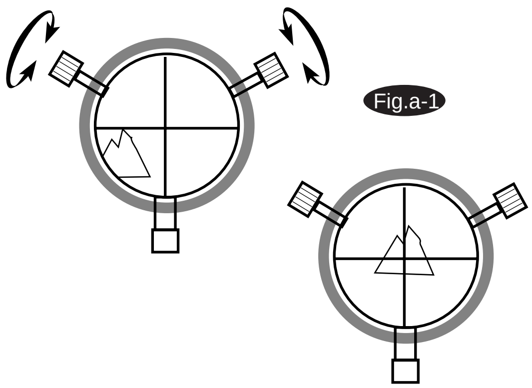


Fig.a-1

These fixed magnification scopes mounted on the optical tube are very useful accessories. When they are correctly aligned with the telescope, objects can be quickly located and brought to the centre of the field. Alignment is best done outdoors in daylight when it's easier to locate objects. If it is necessary to refocus your finderscope, sight on an object that is at least 500 yards (metres) away. Loosen the locking ring by unscrewing it back towards the bracket. The front lens holder can now be turned in and out to focus. When focus is reached, lock it in position with the locking ring (Fig.a).

1) Choose a distant object that is at least 500 yards away and point the main telescope at the object. Adjust the telescope so that the object is in the centre of the view in your eyepiece.
2) Check the finderscope to see if the object centred in the main telescope view is centred on the crosshairs.
3) Adjust the two small screws to centre the finderscope crosshairs on the object (Fig.a-1).

Balancing the telescope

A telescope should be balanced before each observing session. Balancing reduces stress on the telescope mount and allows precise control of micro-adjustment. A balanced telescope is specially critical when doing astrophotography.

The telescope should be balanced after all accessories (eyepiece, camera, etc.) have been attached. Before balancing your telescope, make sure that your tripod is balanced and on a stable surface. For photography, point the telescope in the direction you will be taking photos before performing the balancing steps.

R.A. Balancing

1) Slowly unlock the R.A. and Dec lock levers. Rotate the telescope until both the optical tube and the counterweight rod are horizontal to the ground, and the telescope tube is to the side of the mount (Fig.b).
2) Tighten the Dec. lock lever.
3) Move the counterweights along the counterweight rod until the telescope is balanced and remains stationary when released.
4) Tighten the counterweight thumbscrews to hold the counterweights in their new position.

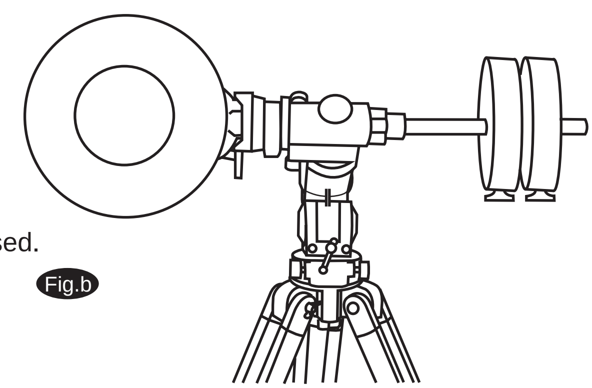


Fig.b

Dec. Balancing

All accessories should be attached to the telescope before balancing around the declination axis. The R.A. balancing should be done befor proceeding with Dec. balancing.

1) Release the R.A. lock lever and rotate R.A. axis so that the counterweight rod is in horizontal position. Tighten the R.A. lock lever.
2) Unlock the Dec. lock lever and rotate telescope tube until it is parallel to the ground.
3) Slowly release the telescope and determine which direction the telescope rotates. Loosen telescope tube rings and slide telescope tube forward or backward in the rings to balance Dec. axis.
4) Once the telescope no longer rotates from its parallel starting position, re-tighten the tube rings and the Dec. lock lever. Reset the altitude axis to your local latitude.

Operating the EQ6 mount

The EQ6 mount has controls for both conventional altitude (up-down) and azimuthal (left-right) directions of motion. Use the altitude adjustment T-bolts for altitude adjustments. These allow fine-adjustment for setting the mount to your local latitude. The azimuthal axis is changed by the two azimuth adjustment knobs located near the tripod head. These allow fine-adjustment of azimuth for polar aligning (Fig.c).

In addition, this mount has direction controls for polar aligned astronomical observing. These directions use Right Ascension (east/west) and Declination (north/south) axis. There are two options to move the telescope in these directions: For large and quick movement, loosen the R.A. lock lever under the R.A. shaft or the Dec. lock lever near the top of the mount (Fig.c-1). For fine adjustments, use the motor drive hand control (see "Using the Hand Control").

There are three numerical scales on this mount. The lower scale on the side of the mount is used for polar alignment of the telescope to your local latitude. The R.A. (Right Ascension) scale is measures hour angle and is adjustable to your local meridian. The declination scale is located near the top of the mount (Fig.c-2).

Fig.c

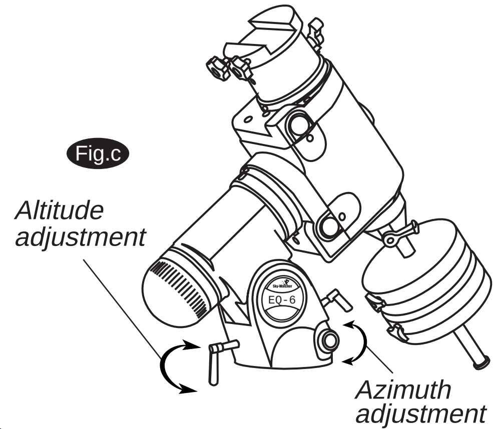


Fig.c-1

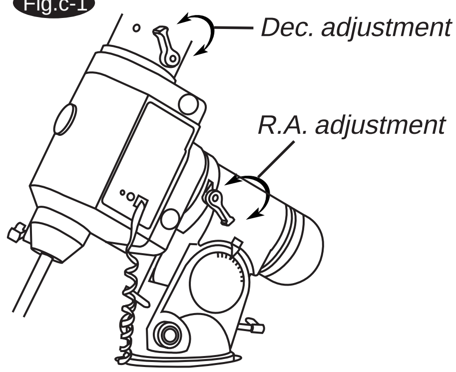
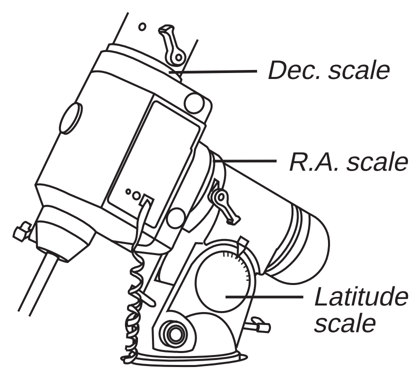


Fig.c-2



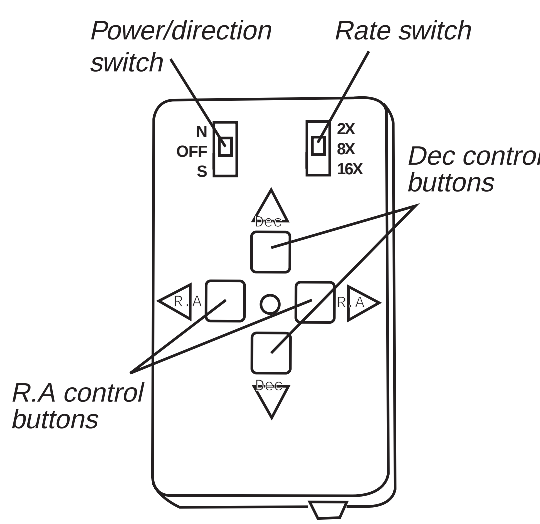
Using the hand control

The N/Off/S switch acts as a power switch as well as controlling the directions of the motors. The "N" position allows R.A. motor to track for the Northern Hemisphere observations and the "S" position is suitable for the Southern Hemisphere (Fig.d). When the EQ6 Hand Control is turned on and all buttons are depressed, the R.A. motor will rotate at the proper speed to compensate for the earth's rotation. The Dec. axis does not automatically rotate. When the mount is correctly polar aligned, you only need to turn the R.A. slow-motion to follow or track objects as they move through the field. The Dec. control is not needed for tracking.

The four push buttons control the directions of the motors. The up-down buttons control the declination motor while the left-right buttons change the R.A. axis.

The rate switch allows changes to the speed rate of the motors from high speed slew rate (16X) to slow micro-adjustment (2X) and the speed in between (8X). When the rate switch is set on "2X", pressing the right R.A. button will rotate the telescope forward at twice the tracking speed or approximately ½º per minute. The left R.A. button stops all motion and allows stars to drift by at their normal rotation rate of approx. ¼º per minute. The "8X" settings allows forward at 8 times the tracking rate and the reverse button moves the telescope backwards at 7 times the tracking rate. The "16X" setting allows forward at 16 times the tracking rate and the reverse button moves the telescope backwards at 15 times the tracking rate.

Fig.d

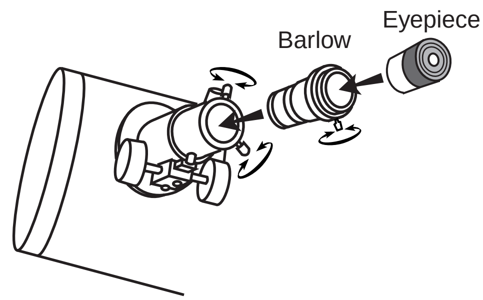


Using the optional Barlow lens

A Barlow is a negative lens which increases the magnifying power of an eyepiece, while reducing the field of view. It expands the cone of the focussed light before it reaches the focal point, so that the telescope's focal length appears longer to the eyepiece.

The Barlow is inserted between the focuser and the eyepiece in a reflector (Fig.e). In addition to increasing magnification, the benefits of using a Barlow lens include improved eye relief, and reduced spherical aberration in the eyepiece. For this reason, a Barlow plus a lens often outperform a single lens producing the same magnification. However, its greatest value may be that a Barlow can potentially double the number of eyepiece in your collection.

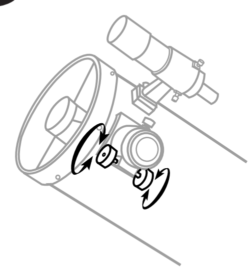
Fig.e



Focusing

Slowly turn the focus knobs under the focuser, one way or the other, until the image in the eyepiece is sharp (Fig.f). The image usually has to be finely refocused over time, due to small variations caused by temperature changes, flexures, etc. This often happens with short focal ratio telescopes, particularly when they haven't yet reached outside temperature. Refocusing is almost always necessary when you change an eyepiece or add or remove a Barlow lens.

Fig.f



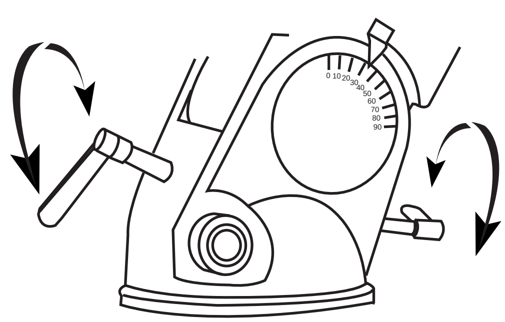
Polar alignment

In order for your telescope to track objects in the sky you have to align your mount. This means tilting the head over so that it points to the North (or South) celestial pole. For people in the Northern Hemisphere this is rather easy as the bright star Polaris is very near the North Celestial Pole. For casual observing, rough polar alignment is adequate. Make sure your equatorial mount is level and the red dot finder is aligned with the telescope before

Setting the latitude

Remove the telescope tube and the counterweights from the mount. Find the latitude and time zone of your current location. A road atlas or GPS unit is useful for your local geographic coordinates. Now look at the side of your mount head, there you will see a scale running from 0-90 degrees (Fig.g). At the base of the head, just above the legs, are two screws (latitude adjustment t-bots) opposite each other under the hinge. All you have to do is loosen one side and tighten the other until your latitude is shown by the indicator pointer (Fig.i). Loosening the front T-bolt first will make the adjustments easier. Small adjustments may be needed after re-attaching the telescope tube and the counterweights.

Fig.g



Polaris, the "Pole Star" is less than one degree from the North Celestial Pole (NCP). Because it is not exactly at the NCP, Polaris appears to trace a small circle around it as the Earth rotates. Polaris is offset from the NCP, toward Cassiopeia and away from the end of the handle of the Big Dipper (Fig.g-1).

Alligning your telescope to Polaris

Unlock the DEC lock knob and rotate the telescope tube until the pointer on the setting circle reads 90˚. Retighten the DEC lock knob. Move the tripod so that the equatorial mount faces north and the R.A. axis points roughly at Polaris. A hand campass is useful for this step. Use the two azimuth adjustment knobs on the mount base to make fine adjustments in azimuth if needed (Fig.g-2). For more accurate allignment, look through the finderscope and centre the Polaris on the crosshairs.

Southern Hemisphere

In the Southern Hemisphere you must align the mount to the SCP by locating its position with star patterns, without the convenience of a nearby bright star. The closest star is the faint 5.5-mag. Sigma Octanis which is about one degree away. Two sets of pointers which help to locate the SCP are alpha and beta Crucis (in the Southern Cross) and a pointer running at a right angle to a line connecting alpha and beta Centauri (Fig.g-3).

Fig.g-1

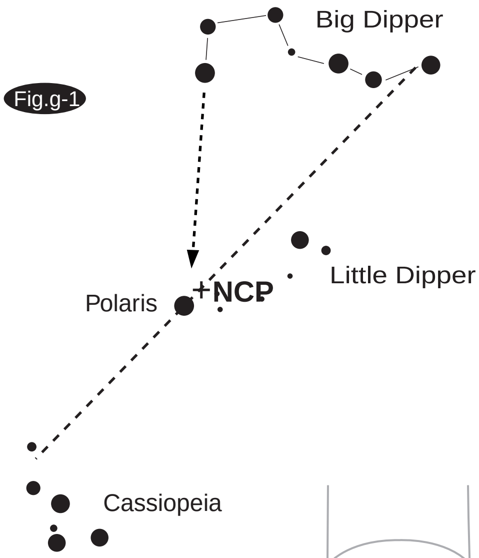
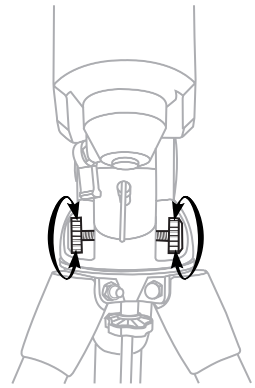


Fig.g-2



The Polarscope

The pole-finder telescope supplied with the EQ-6 Mount can be used for accurate polar alignment. This method of polar alignment is sufficient for virtually all visual use of the telescope.

To use the Polarscope with the EQ-6 mount, the declination axis must be rotated such that the hole in the shaft is in front of the Polarscope. If possible, this procedure should be carried out while the telescope and counterweights are on the mount. This prevents the mount from becoming mis-aligned when the load on the tripod is changed. Be sure that the tripod is level. This will make it easier to use the Azimuth and Altitude adjustments on the mount when trying to center the stars in the polar scope. The tripod can be made level by using a bubble level or carpenter's level. Remove the caps from the upper and lower ends of the Right Ascension (R.A.) axis (Fig.h). Looking through the polar scope, lines should be seen super-imposed on the sky. If these lines are not visible, shine a red flashlight down the upper end of the RA axis to illuminate the top end of the pole finder.

Aligning the Polarscope

The optical axis of the polar scope is already aligned with the rotation axis of the mount. The optical axis of the polar scope can not be adjusted. This is set permanently at the factory. The reticle in the polar scope must be centered on the optical axis of the polar scope. If this is not the case, the polar alignment will not be accurate.

Fig.g-3

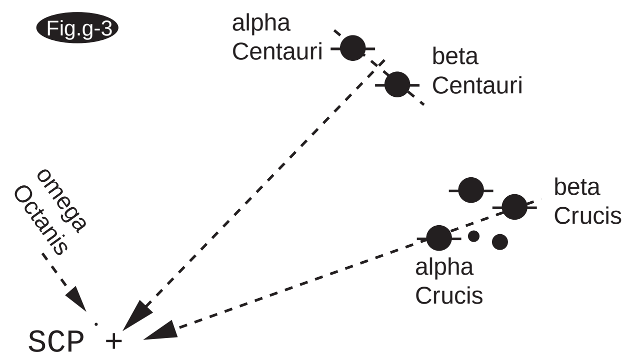
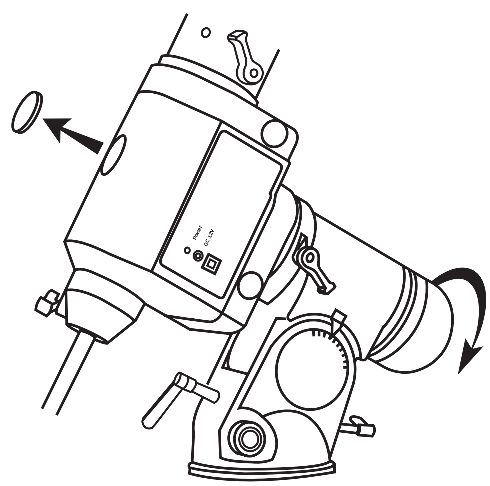


Fig.h



Locate Polaris and place it in the center of the Polarscope by adjusting the Altitude and Azimuth of the mount. Place Polaris directly under the cross in the center of the reticle (Fig.h-1). Rotate the mount one half turn about the R.A. axis. Polaris should remain under the cross in the center of the reticle. If it does not, the reticle is not centered on the R.A. axis of the mount.

To move the reticle, adjust the three small Allen screws (Fig.h-2) on the polar scope. Make small adjustments by moving only two of the screws at a time. Adjust the screws to move Polaris ***half*** the distance back to the center of the reticle. This is because Polaris started in the center of the reticle. By rotating the mount 180 degrees, Polaris moved exactly twice the distance between the center of the reticle and the center of rotation. The center of rotation lies midway between the center of the reticle and the new position of Polaris. Do not turn any of the set screws more than one quarter turn at a time or the reticle will disengage from the set screws. Do not tighten these screws too much or the stress will fracture the lenses in the polar scope.

Now re-center Polaris under the cross in the middle of the reticle using the azimuth and altitude adjustments. Repeat the entire procedure until Polaris remains in the center of the reticle when the mount is rotated about the R.A. axis.

With some practice, you should be able to align the reticle with the R.A. axis to within about 2 or 3 arc-minutes. You should never have to make this adjustment again, unless the polar scope has been dropped, disassembled, or if the polar scope is to be used on another mount. If Polaris is not visible from your area, you can use a distant object such as the top of a telephone pole, or a distant mountain-top. These objects are larger than the image of a star, so they will not provide as accurate an alignment.

Using the Polarscope in the Northern Hemisphere

There is only one easily visible star near the North Celestial Pole. This star is Polaris. The rest of the stars in Ursa Minor are around Magnitude 5 and require very dark skies to become visible (Fig.h-3).

Since Polaris is not exactly on the North Celestial Pole, you need to offset the telescope's R.A. axis from Polaris by a small amount in the correct direction. There is a radial line in the Polarscope. Along this line, there are tick marks and a circle. Rotate the mount in R.A. until this line points towards Beta-Ursa Minoris (Fig.h-4). If this star can not be seen, Mizar, the second star in the Big Dipper's handle, can be used. If these stars can not be seen, point the line in the pole finder away from the constellation Cassiopeia. Set the lock on the R.A. axis so the mount does not rotate.

Adjust the mount in Altitude and Azimuth again, until Polaris is in the circle on the line in the pole finder (Fig.h-4).

Fig.h-1

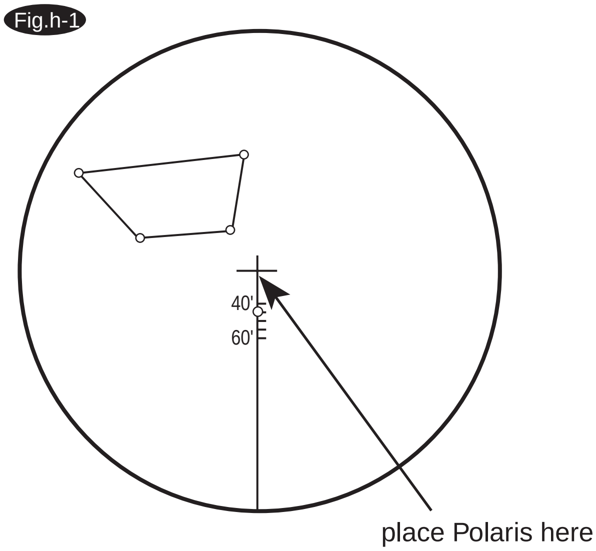


Fig.h-2

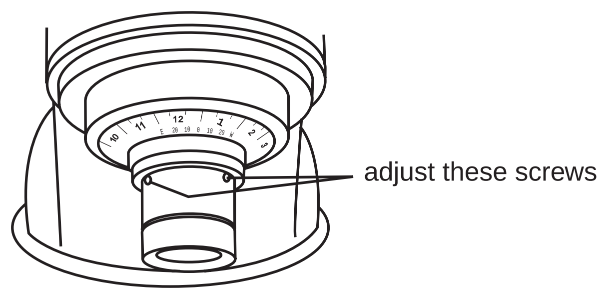
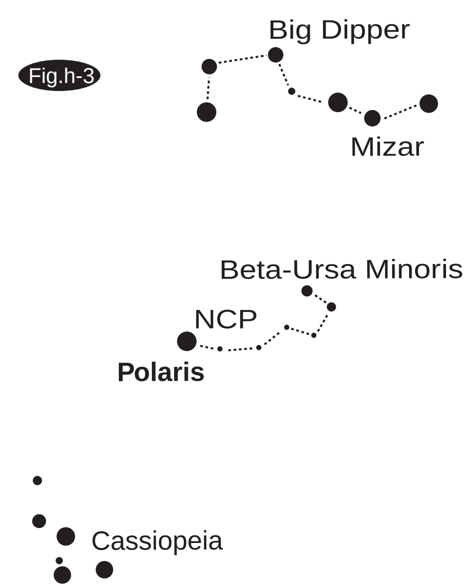


Fig.h-3

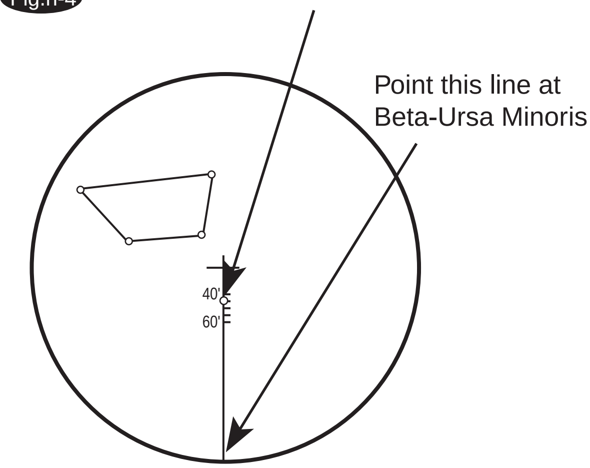


The polar alignment is now complete. This should get the mount's R.A. axis within 5 arc-minutes of the celestial pole. Due to its proper motion, Polaris can be seen to move with respect to the Pole from year to year. The tick marks in the Polarscope can be used to compensate for this motion. Fig.h-5 can be used to determine the current position of Polaris along the line in the polarscope.

Using the Polarscope in the Sorthern Hemisphere

There is a 4-star pattern in the polar scope, which resembles the bucket of the Big Dipper. In the Southern Hemisphere, there is an Asterism in Octans, which has this shape. By rotating the R.A. axis and by adjusting the altitude and azimuth of the mount, the four stars in the Asterism can be placed in the circles in the Pole Finder (Fig.h-6). This procedure can be somewhat difficult in the city because all four of these stars are fainter than Magnitude 5.

Fig.h-4



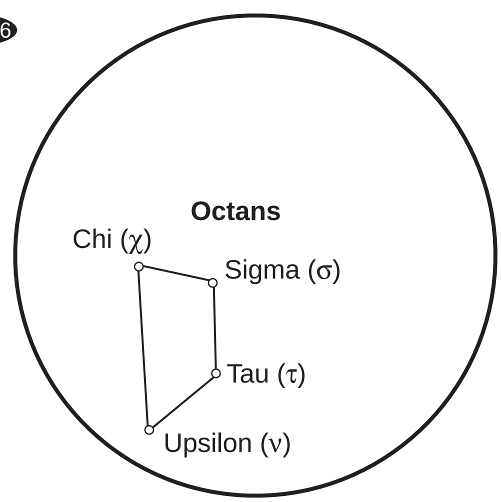
Tracking celestial objects

When observing through a telescope, astronomical objects appear to move slowly through the telescope's field of view. When the mount is correctly polar aligned, and the motors are on, the R.A. motor will start rotating the mount to track objects as they move through the field. The rotation speed of the R.A. drive matches the Earth's rotation rate for stars to appear stationary in the telescope eyepiece. No further adjustments in the azimuth and latitude of the mount should be made in the observing session, nor should you move the tripod. Only movements in R.A. and DEC axis should be made. The DEC. motion control is very useful for doing astrophotography but not needed for tracking.

Fig.h-5

Year	Distance
2000	45'
2002	44'
2004	44'
2006	43'
2008	43'
2010	42'
2012	42'
2014	41'
2016	40'
2018	40'
2020	39'

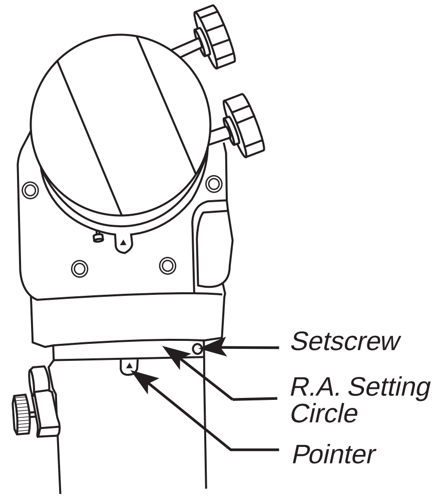
Fig.h-6



Setting circles

The quickest way to find objects is to learn the Constellations and use the finderscope, but if the object is too faint you may want to use setting circles on an equatorial mount. Setting circles enable you to locate celestial objects whose celestial co-ordinates have been determined from star charts. Your telescope must be Polar aligned and the R.A. setting circle must be calibrated before using the setting circles.

Fig.i



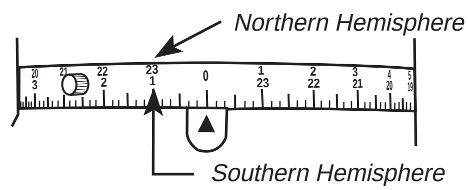
Reading the R.A. setting circle

The telescope's R.A. setting circle is scaled in hours, from 1 through 24, with small lines in between representing 10 minute increments. The upper set of numbers apply to viewing in the Northern Hemisphere, while the numbers below them apply to viewing in the Southern Hemisphere. (Fig.i-1).

Setting (calibrating) the R.A. setting circle

In order to set your Right Ascension circle you must first find a star in your field of view with known coordinates. A good one would be the 0.0 magnitude star Vega in the Constellation Lyra. From a star chart we know the R.A. coordinate of Vega is 18h 36m. Loosen the R.A. and DEC. lock knobs on the mount and adjust the telescope so that Vega is centred in the field of view of the eyepiece. Tighten the R.A. and DEC. lock knobs to lock the mount in place. Now rotate the R.A. setting circle until it reads 18h36m. Your are now ready to use the setting circles to find objects in the sky.

Fig.i-1



Finding objects using the setting circles

Example: Finding the faint planetary nebula M57; "The Ring"

From a star chart, we know the coordinates of the Ring are Dec. 33º and R.A. 18h52m. Unlock the DEC lock knob and rotate your telescope in DEC until the pointer on the DEC setting circle reads 33º. Re-tighten the DEC lock knob. Loosen the R.A. lock knob and rotate the telescope in R.A. until the pointer on the R.A. setting circle reads 18h52m (do not move the R.A. circle). Re-tighten the R.A. lock knob. Now look through the Red Dot Finder to see if you have found M57. Adjust the telescope with R.A. and DEC. flexible cables until M57 is centred in the Red Dot Finder. Now look through the telescope using a low power eyepiece. Centre M57 in the field of view of the eyepiece.

If you are familiar with the night sky, it is sometimes convenient to find an object using only the DEC coordinate. Loosen the DEC lock knob and rotate the telescope in DEC until the pointer on the DEC setting circle reads 33º. Re-tighten the DEC lock knob. Now traverse through Lyra in R.A. axis until M57 appeares in the field of view.

The setting circles will get you close to the object you wish to observe, but are not accurate enough to put it in the centre of your Red Dot Finder's field of view. The accuracy of your setting circles also depends on how accurate your telescope is polar aligned.

Choosing the appropriate eyepiece

Calculating the magnification (power)

The magnification produced by a telescope is determined by the focal length of the eyepiece that is used with it. To determine a magnification for your telescope, divide its focal length by the focal length of the eyepieces you are going to use. For example, a 10mm focal length eyepiece will give 80X magnification with an 800mm focal length telescope.

$$\text{magnification} = \frac{\text{Focal length of the telescope}}{\text{Focal length of the eyepiece}} = \frac{800\text{mm}}{10\text{mm}} = 80\text{X}$$

When you are looking at astronomical objects, you are looking through a column of air that reaches to the edge of space and that column seldom stays still. Similarly, when viewing over land you are often looking through heat waves radiating from the ground, house, buildings, etc. Your telescope may be able to give very high magnification but what you end up magnifying is all the turbulence between the telescope and the subject. A good rule of thumb is that the usable magnification of a telescope is about 2X per mm of aperture under good conditions.

Calculating the field of view

The size of the view that you see through your telescope is called the true (or actual) field of view and it is determined by the design of the eyepiece. Every eyepiece has a value, called the apparent field of view, which is supplied by the manufacturer. Field of view is usually measured in degrees and/or arc-minutes (there are 60 arc-minutes in a degree). The true field of view produced by your telescope is calculated by dividing the eyepiece's apparent field of view by the magnification that you previously calculated for the combination. Using the figures in the previous magnification example, if your 10mm eyepiece has an apparent field of view of 52 degrees, then the true field of view is 0.65 degrees or 39 arc-minutes.

$$\text{True Field of View} = \frac{\text{Apparent Field of View}}{\text{Magnification}} = \frac{52^\circ}{80\text{X}} = 0.65^\circ$$

To put this in perspective, the moon is about 0.5˚ or 30 arc-minutes in diameter, so this combination would be fine for viewing the whole moon with a little room to spare. Remember, too much magnification and too small a field of view can make it very hard to find things. It is usually best to start at a lower magnification with its wider field and then increase the magnification when you have found what you are looking for. First find the moon then look at the shadows in the craters!

Calculating the exit pupil

The Exit Pupil is the diameter (in mm) of the narrowest point of the cone of light leaving your telescope. Knowing this value for a telescope-eyepiece combination tells you whether your eye is receiving all of the light that your primary lens or mirror is providing. The average person has a fully dilated pupil diameter of about 7mm. This value varies a bit from person to person, is less until your eyes become fully dark adapted and decreases as you get older. To determine an exit pupil, you divide the diameter of the primary of your telescope (in mm) by the magnification.

$$\text{Exit Pupil} = \frac{\text{Diameter of Primary mirror in mm}}{\text{Magnification}}$$

For example, a 200mm f/5 telescope with a 40mm eyepiece produces a magnification of 25x and an exit pupil of 8mm. This combination can probably be used by a young person but would not be of much value to a senior citizen. The same telescope used with a 32mm eyepiece gives a magnification of about 31x and an exit pupil of 6.4mm which should be fine for most dark adapted eyes. In contrast, a 200mm f/10 telescope with the 40mm eyepiece gives a magnification of 50x and an exit pupil of 4mm, which is fine for everyone.

Sky conditions

Sky conditions are usually defined by two atmospheric characteristics, seeing, or the steadiness of the air, and transparency, light scattering due to the amount of water vapour and particulate material in the air. When you observe the Moon and the planets, and they appear as though water is running over them, you probably have bad "seeing" because you are observing through turbulent air. In conditions of good "seeing", the stars appear steady, without twinkling, when you look at them with unassisted eyes (without a telescope). Ideal "transparency" is when the sky is inky black and the air is unpolluted.

Selecting an observing site

Travel to the best site that is reasonably accessible. It should be away from city lights, and upwind from any source of air pollution. Always choose as high an elevation as possible; this will get you above some of the lights and pollution and will ensure that you aren't in any ground fog. Sometimes low fog banks help to block light pollution if you get above them. Try to have a dark, unobstructed view of the horizon, especially the southern horizon if you are in the Northern Hemisphere and vice versa. However, remember that the darkest sky is usually at the "Zenith", directly above your head. It is the shortest path through the atmosphere. Do not try to observe any object when the light path passes near any protrusion on the ground. Even extremely light winds can cause major air turbulence as they flow over the top of a building or wall.

Observing through a window is not recommended because the window glass will distort images considerably. And an open window can be even worse, because warmer indoor air will escape out the window, causing turbulence which also affects images. Astronomy is an outdoor activity.

Choosing the best time to observe

The best conditions will have still air, and obviously, a clear view of the sky. It is not necessary that the sky be cloud-free. Often broken cloud conditions provide excellent seeing. Do not view immediately after sunset. After the sun goes down, the Earth is still cooling, causing air turbulence. As the night goes on, not only will seeing improve, but air pollution and ground lights will often diminish. Some of the best observing time is often in the early morning hours. Objects are best observed as they cross the meridian, which is an imaginary line that runs through the Zenith, due North-South. This is the point at which objects reach their highest points in the sky. Observing at this time reduces bad atmospheric effects. When observing near the horizon, you look through lots of atmosphere, complete with turbulence, dust particles and increased light pollution.

Cooling the telescope

Telescopes require at least 10 to 30 minutes to cool down to outside air temperature. This may take longer if there is a big difference between the temperature of the telescope and the outside air. This minimizes heat wave distortion inside telescope tube (tube currents). Allow a longer cooling time for larger optics. If you are using an equatorial mount, use this time for polar alignment.

Adapting your eyes

Do not expose your eyes to anything except red light for 30 minutes prior to observing. This allows your pupils to expand to their maximum diameter and build up the levels of optical pigments, which are rapidly lost if exposed to bright light. It is important to observe with both eyes open. This avoids fatigue at the eyepiece. If you find this too distracting, cover the non-used eye with your hand or an eye patch. Use averted vision on faint objects: The center of your eye is the least sensitive to low light levels. When viewing a faint object, don't look directly at it. Instead, look slightly to the side, and the object will appear brighter.

Collimating a Newtonian reflector

Collimation is the process of aligning the mirrors of your telescope so that they work in concert with each other to deliver properly focused light to your eyepiece. By observing out-of-focus star images, you can test whether your telescope's optics are aligned. Place a star in the centre of the field of view and move the focuser so that the image is slightly out of focus. If the seeing conditions are good, you will see a central circle of light (the Airy disc) surrounded by a number of diffraction rings. If the rings are symmetrical about the Airy disc, the telescope's optics are correctly collimated (Fig.j).

If you do not have a collimating tool, we suggest that you make a "collimating cap" out of a plastic 35mm film canister (black with gray lid). Drill or punch a small pinhole in the exact center of the lid and cut off the bottom of the canister. This device will keep your eye centered of the focuser tube. Insert the collimating cap into the focuser in place of a regular eyepiece.

Collimation is a painless process and works like this:

Pull off the lens cap which covers the front of the telescope and look down the optical tube. At the bottom you will see the primary mirror held in place by three clips 120º apart, and at the top the small oval secondary mirror held in a support and tilted 45º toward the focuser outside the tube wall (Fig.j-1).

The secondary mirror is aligned by adjusting the three smaller screws surrounding the central bolt. The primary mirror is adjusted by the three adjusting screws at the back of your scope. The three locking screws beside them serve to hold the mirror in place after collimation. (Fig.j-2)

Aligning the Secondary Mirror

Point the telescope at a lit wall and insert the collimating cap into the focuser in place of a regular eyepiece. Look into the focuser through your collimating cap. You may have to twist the focus knob a few turns until the reflected image of the focuser is out of your view. Note: keep your eye against the back of the focus tube if collimating without a collimating cap. Ignore the reflected image of the collimating cap or your eye for now, instead look for the three clips holding the primary mirror in place. If you can't see them (Fig.j-3), it means that you will have to adjust the three bolts on the top of the secondary mirror holder, with possibly an Allen wrench or Phillip's screwdriver. You will have to alternately loosen one and then compensate for the slack by tightening the other two. Stop when you see all three mirror clips (Fig.j-4). Make sure that all three small alignment screws are tightened to secure the secondary mirror in place.

Fig.j

Corretly aligned — Needs collimation

Fig.j-1

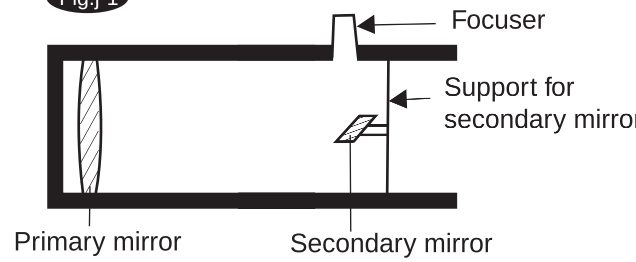


Fig.j-2

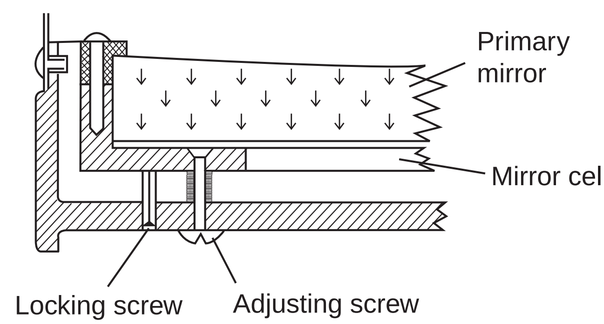


Fig.j-3

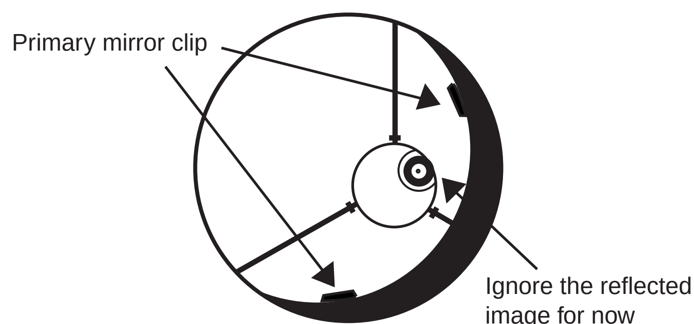
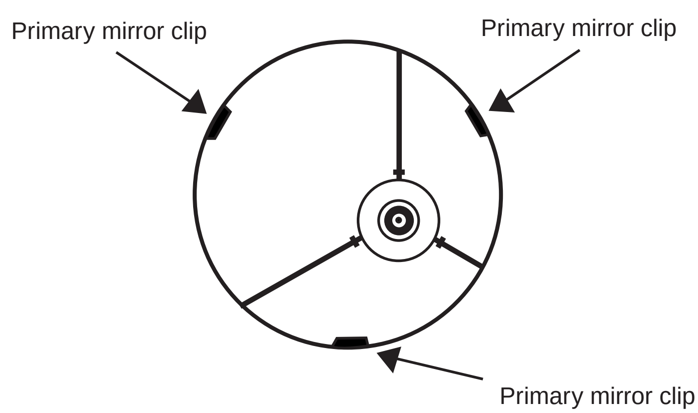


Fig.j-4



Aligning the Primary Mirror

There are flat headed screws and 3 thumbscrews at the back of your telescope, the flat headed screws are the locking screws and the thumbscrews are the adjusting screws (Fig.j-5). Loosen the flat headed screws by a few turns. Now run your hand around the front of your telescope keeping your eye to the focuser, you will see the reflected image of your hand. The idea here being to see which way the primary mirror is defected, you do this by stopping at the point where the reflected image of the secondary mirror is closest to the primary mirrors' edge (Fig.j-6).

When you get to that point, stop and keep your hand there while looking at the back end of your telescope, is there a adjusting screw there? If there is you will want to loosen it (turn the screw to the left) to bring the mirror away from that point. If there isn't a adjusting screw there, then go across to the other side and tighten the adjusting screw on the other side. This will gradually bring the mirror into line until it looks like Fig.j-7. Secure the mirror position by tightening the locking screws. (It helps to have a friend to help for primary mirror collimation. Have your partner adjust the adjusting screws according to your directions while you look in the focuser.)

After dark go out and point your telescope at Polaris, the North Star. With an eyepiece in the focuser, take the image out of focus. You will see the same image only now, it will be illuminated by starlight. If necessary, repeat the collimating process only keep the star centered while tweaking the mirror.

Fig.j-5

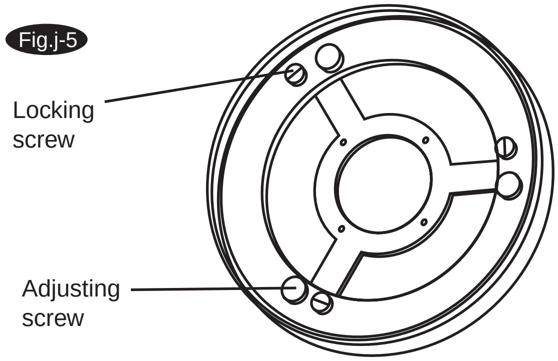


Fig.j-6

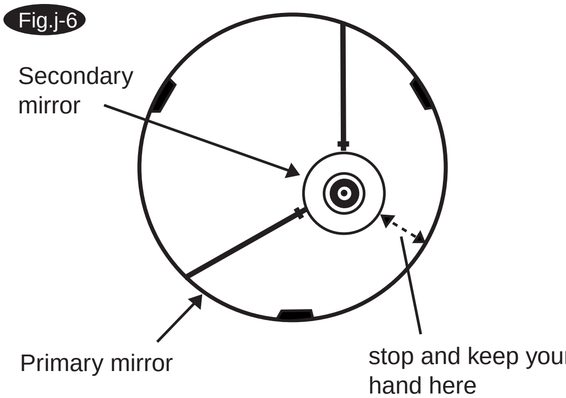
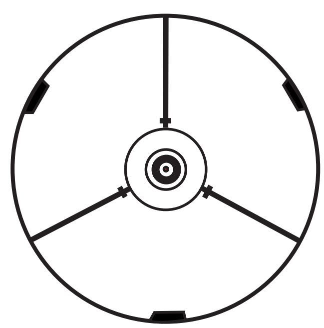
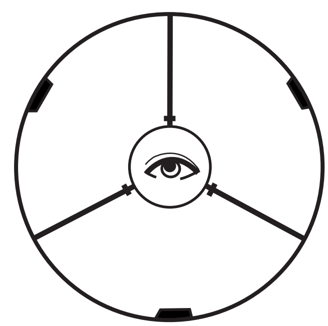


Fig.j-7



Both mirrors aligned with collimating cap in



Both mirrors aligned with eye looking in focuser

Cleaning your telescope

Replace the dust cap over end of telescope whenever not in use. This prevents dust from settling on mirror or lens surface. Do not clean mirror or lens unless you are familiar with optical surfaces. Clean finderscope and eyepieces with special lens paper only. Eyepieces should be handled with care, avoid touching optical surfaces.

NEVER USE YOUR TELESCOPE TO LOOK DIRECTLY AT THE SUN. PERMANENT EYE DAMAGE WILL RESULT. USE A PROPER SOLAR FILTER FOR VIEWING THE SUN. WHEN OBSERVING THE SUN, PLACE A DUST CAP OVER YOUR FINDERSCOPE TO PROTECT IT FROM EXPOSURE. NEVER USE AN EYEPIECE-TYPE SOLAR FILTER AND NEVER USE YOUR TELESCOPE TO PROJECT SUNLIGHT ONTO ANOTHER SURFACE, THE INTERNAL HEAT BUILD-UP WILL DAMAGE THE TELESCOPE OPTICAL ELEMENTS.