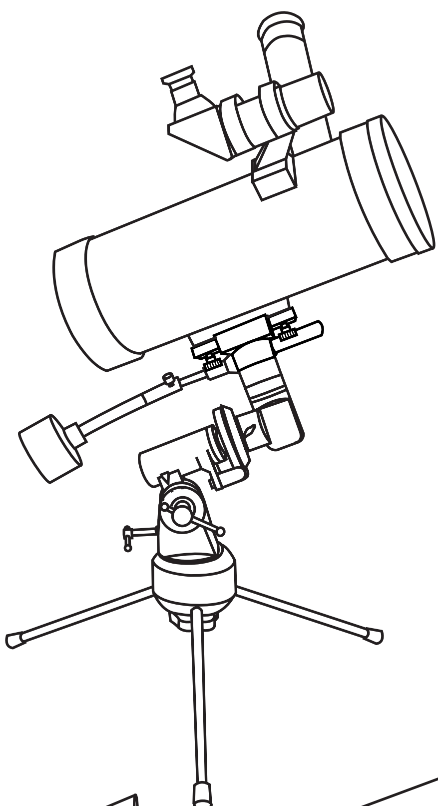
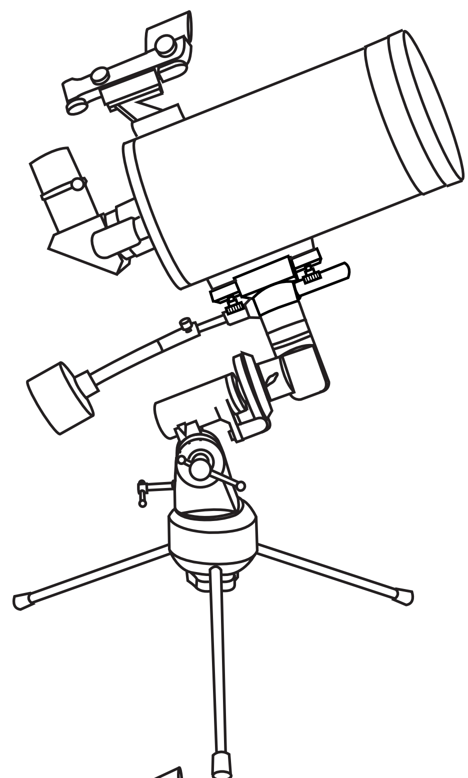
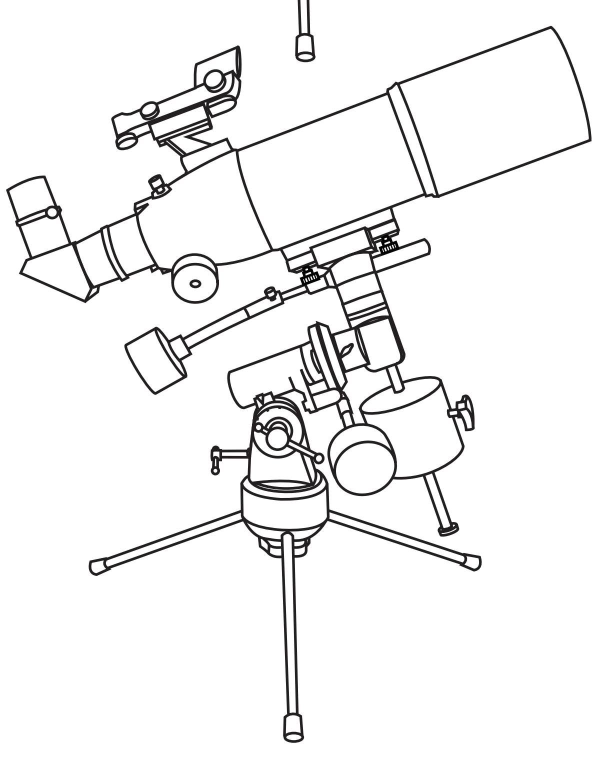
# INSTRUCTION MANUAL

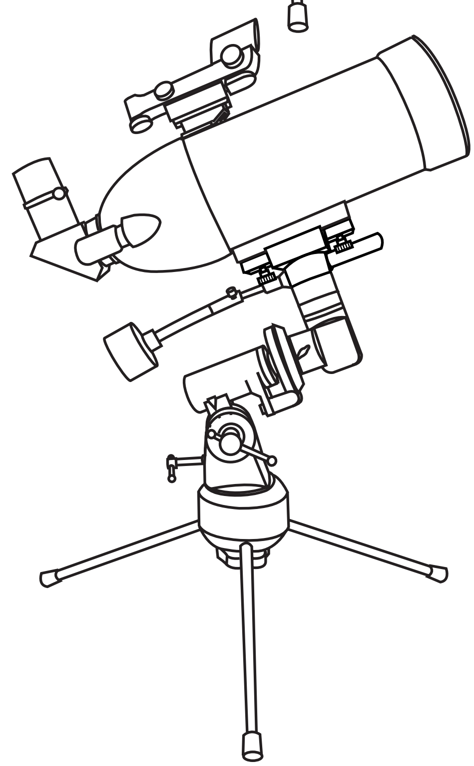
## TABLETOP TELESCOPES

**SK 763 EQ/TA SK MAK90 EQ/TA**
**SK 804 EQ/TA SK 8035 EQ/TA**

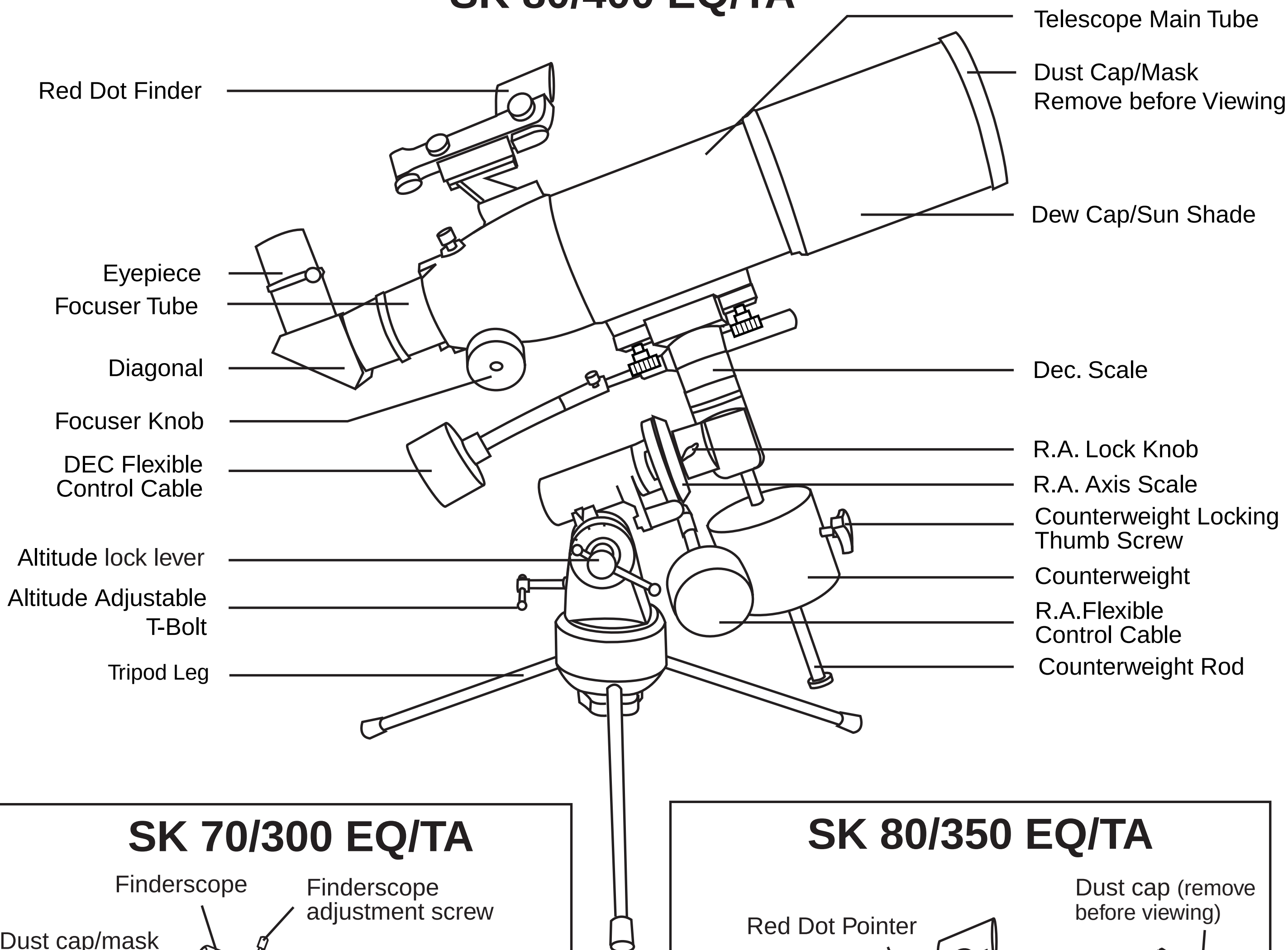




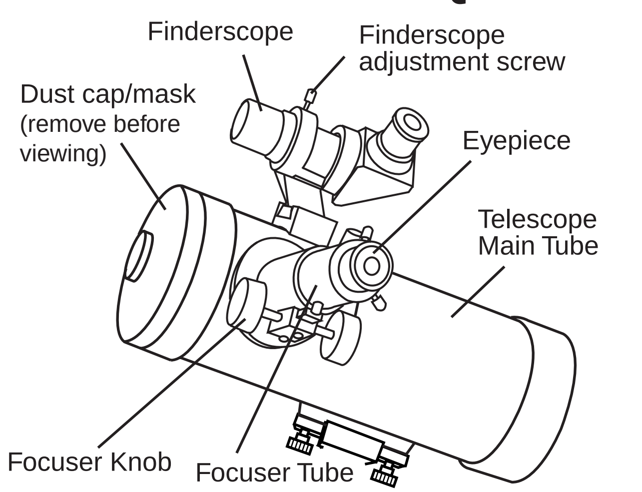




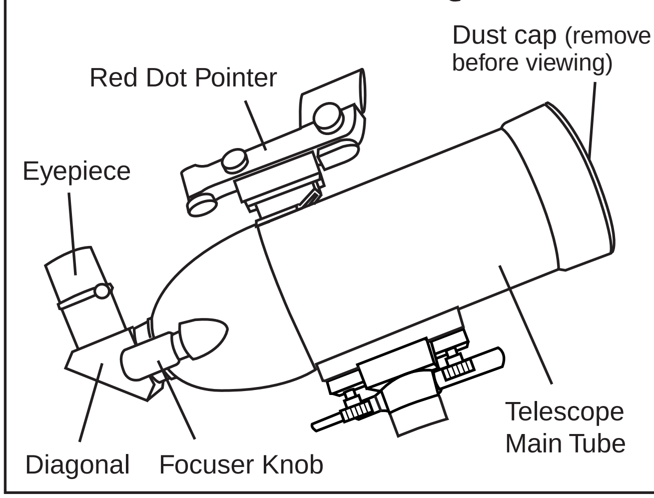
# SK 80/400 EQ/TA




## SK 70/300 EQ/TA




## SK 80/350 EQ/TA

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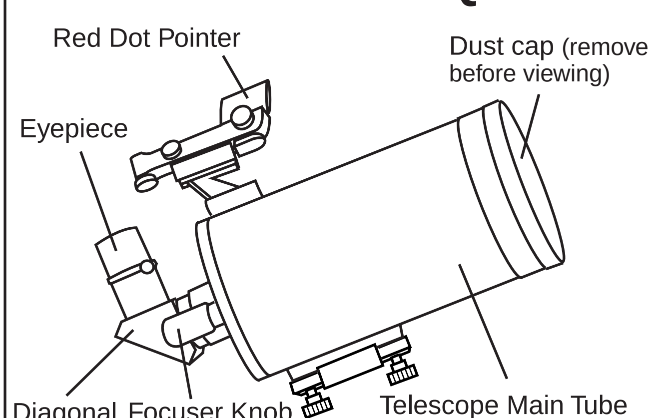

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## Before you begin

This instruction manual is applicable to all the models listed on the cover. Take a moment to find the model number of your telescope on page 2. Follow the instructions for your specific model in the manual. 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.

## Caution!

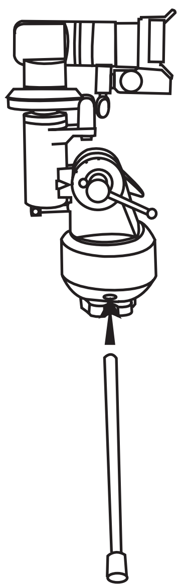
NEVER USE YOUR TELESCOPE TO LOOK DIRECTLY AT THE SUN. PERMANENT EYE DAMAGE WILL RESULT. USE A PROPER SOLAR FILTER FOR VIEWING THE SUN. WHEN OBSERVING THE SUN, PLACE A DUST CAP OVER YOUR FINDERSCOPE TO PROTECT IT FROM EXPOSURE. NEVER USE AN EYEPIECE-TYPE SOLAR FILTER AND NEVER USE YOUR TELESCOPE TO PROJECT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

# MOUNT ASSEMBLY (for all models)

## INSTALLING THE TRIPOD LEGS (Fig.1)

Screw the three tripod legs into holes in the tripod base.

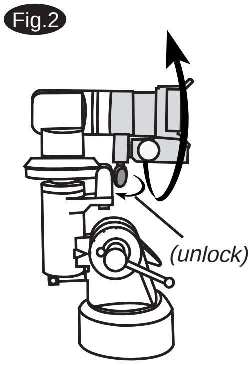
Fig.1



## REPOSITIONING THE MOUNT HEAD (Fig.2-6)

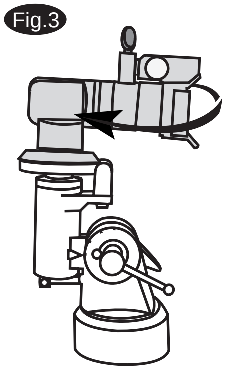
Unlock the DEC lock knob. Swivel 180˚.

Fig.2




Unlock the R.A. lock knob on the other side. Swivel 180˚.

Fig.3



Unlock the altitude lock knob. Set the angle to local altitude.

Fig.4

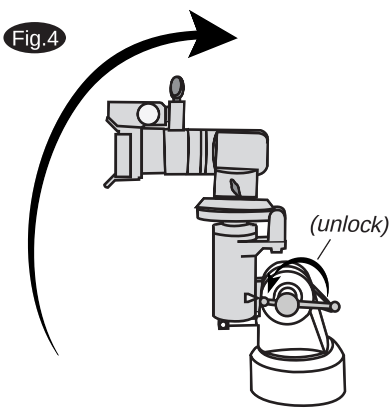



Fig.5

*Swivel 180˚.*

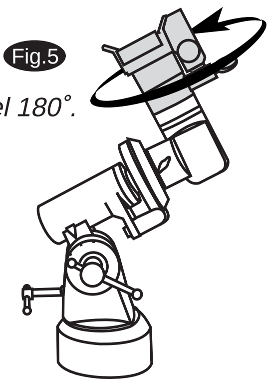
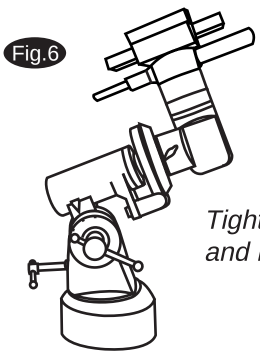


Fig.6

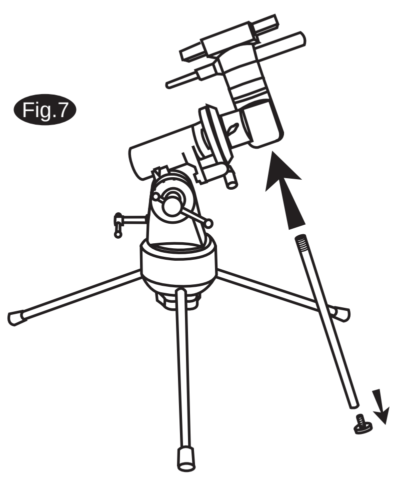


*Tighten altitude,DEC and R.A. knobs.*

## INSTALLING THE COUNTER-WEIGHT ROD (Fig.7)

1) Screw counterweight rod into threaded hole on the end of the declination shaft.
2) Unscrew the threaded cap from the end of the counterweight rod.

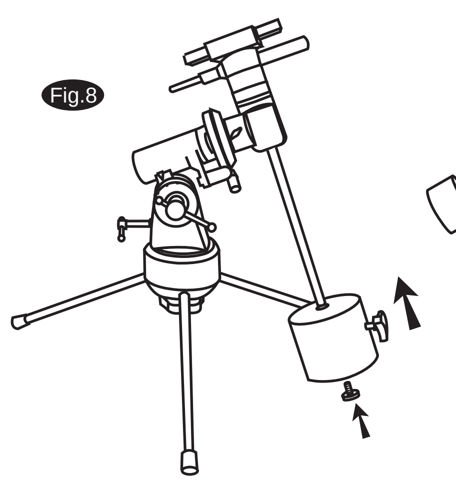
Fig.7



## INSTALLING THE COUNTER-WEIGHT (Fig.8)

1) Slide the counterweight halfway along counterweight rod. Tighten counterweight thumbscrew to secure.
2) Replace cap on the end of counterweight rod.

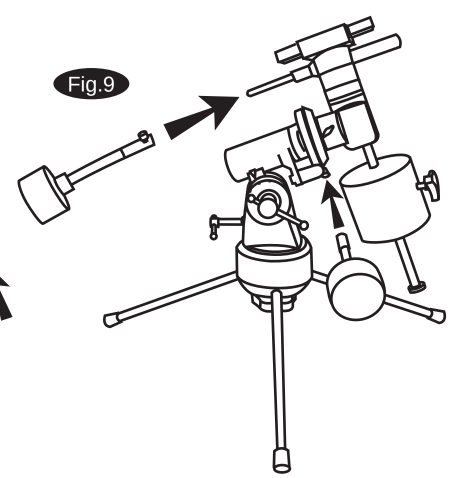
Fig.8



## INSTALLING CONTROL CABLES(Fig.9)

Slide the sleeve end of the cable over the nipple on the end of the worm gear. Tighten the cable using the set screw against the flat surface on the nipple.

Fig.9



# TELESECOPE ASSEMBLY (for SK 80/350 EQ/TA, SK 80/400 EQ/TA and SK MAK90 EQ/TA. SK 80/400 EQ/TA shown here)

### ATTACHING THE TELESCOPE MAIN TUBE TO THE MOUNT (Fig.10)

1) Place the telescope tube on the mount, secure with the 2 thumb-screws and washers from underneath.

### ATTACHING THE RED DOT FINDER (Fig.11)

***SK 80/350 EQ/TA***: Slide the red dot finder into the grooves on the bracket and tighten the Phillip's head screws with a screw driver.

***SK MAK90 EQ/TA***: Slide the red dot finder bracket into the rectangular slot and tighten the screw to hold the red dot finder in place.

### INSERTING THE EYEPIECE (Fig.12)

1) Loosen the thumbscrews on the end of the focus tube.
2) Insert diagonal into focus tube and re-tighten thumbscrews to hold the diagonal in place.
3) Loosen the thumbscrews on the diagonal.
4) Insert the desired eyepiece into diagonal and secure by re-tightening thumbscrews.

Fig.10

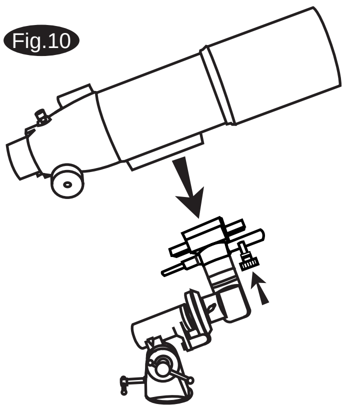


Fig.11

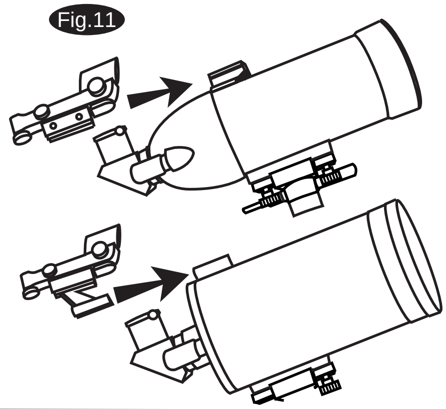
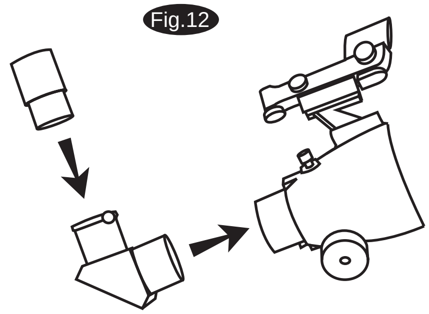


Fig.12



# TELESECOPE ASSEMBLY (for SK 76/300 EQ/TA only)

### ATTACHING THE TELESCOPE MAIN TUBE TO THE MOUNT (Fig.13)

1) Place the telescope tube on the mount, secure with the 2 thumb-screws and washers from underneath.

### ATTACHING THE FINDERSCOPE (Fig.14)

1) Locate finderscope optical assembly.
2) Slide finderscope assembly into the rectancular slot and tighten the thumbscrew to hold the bracket in place.

### INSERTING THE EYEPIECE (Fig.15)

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

Fig.13

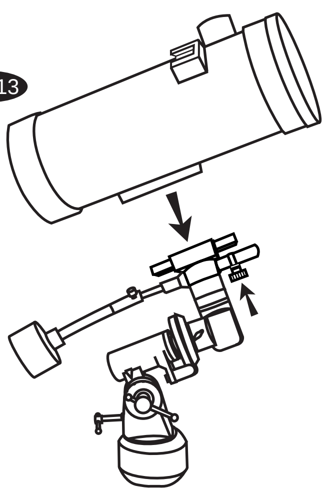


Fig.14

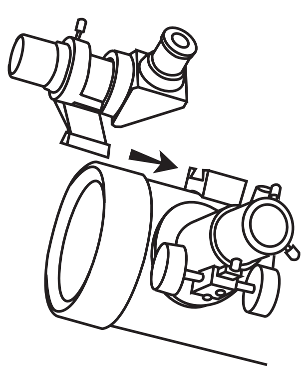
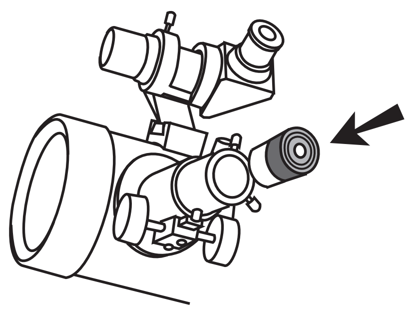


Fig.15



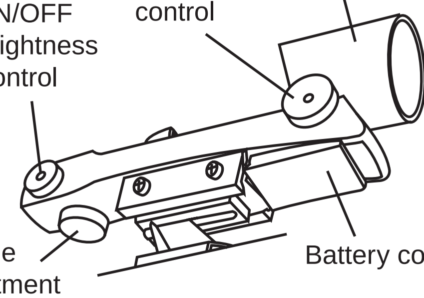
# OPERATING YOUR TELESCOPE

## Using the Red Dot Finder

**(for SK 80/350 EQ/TA, SK 80/400 EQ/TA, and SK MAK90EQ/TA)**

The Red Dot Finder is a zero magnification pointing tool that uses a coated glass window to superimpose the image of a small red dot onto the night sky. The Red Dot Finder is equipped with a variable brightness control, azimuth adjustment control, and altitude adjustment control (Fig.a). The Red Dot Finder is powered by a 3-volt lithium battery located underneath at the front. To use the Finder, simply look through the sight tube and move your telescope until the red dot merges with the object. Make sure to keep both eyes open when sighting.

Fig.a

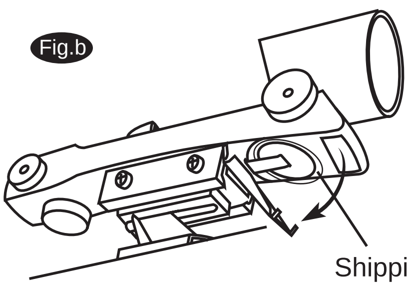



### Aligning the Red Dot Finder

Like all finderscopes, the Red Dot Finder must be properly aligned with the main telescope before use. This is a simple process using the azimuth and altitude control knobs.

1. Open the battery cover by pulling it down and remove the plastic shipping cover over the battery (Fig.b).
2. Turn on the Red Dot Finder by rotating the variable brightness control clockwise until you hear a "click". Continue rotating the control knob to increase the brightness level.
3. Insert a low power eyepiece into the telescope's focuser. Locate a bright object and position the telescope so that the object is in the centre of the field of view.
4. With both eyes open, look through the sight tube at the object. If the red dot overlaps the object, your Red Dot Finder is perfectly aligned. If not, turn its azimuth and altitude adjustment controls until the red dot is merged with the object.

Fig.b

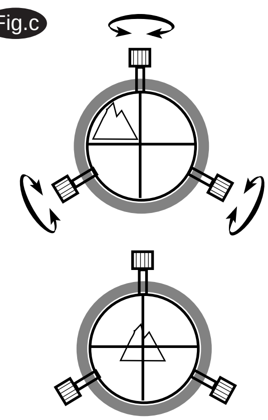



## Using the finderscope (for SK 76/300 EQ/TA only)

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 day light when it's easier to locate objects.

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. Use the three alignment screws to centre the finderscope crosshairs on the object (Fig.c).

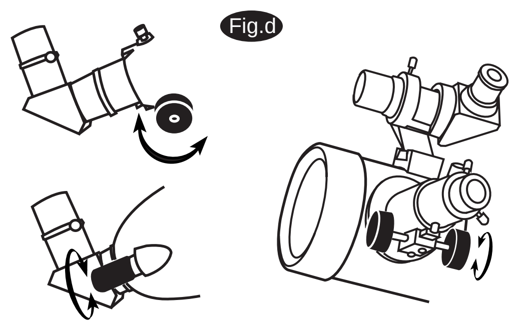
Fig.c



## Focusing (for all models)

Slowly turn the focuser knobs (Fig.d), one way or the other, until the image in the eyepiece is sharp. 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.d



# Operating the EQ1 mount (for all models)

The EQ1 mount has controls for both conventional altitude (up-down) and azimuth (left-right) directions of motion. These two adjustments are suggested for large direction changes and for terrestrial viewing. Use the large knurled knob located underneath for azimuth adjustments. Loosen the knob and rotate the mount head around the azimuth axis. Use the altitude adjustment T-bolts for altitude adjustments (Fig.e).

In addition, this mount has Right Ascension (hour angle) and declination direction controls for polar-aligned astronomical observing. Loosen the lock knobs to make large direction changes. Use the control cables for fine adjustment after the lock knobs have both been locked (Fig.f). An additional scale is included for the altitude axis. This allows polar alignment for your local latitude. (Fig.g)

Fig.e

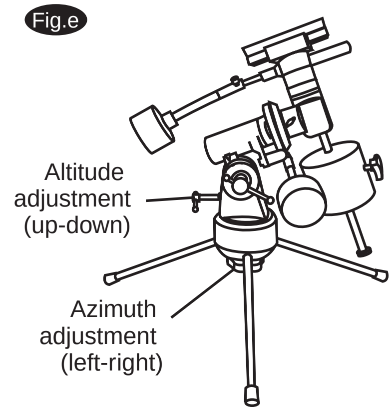



Fig.f

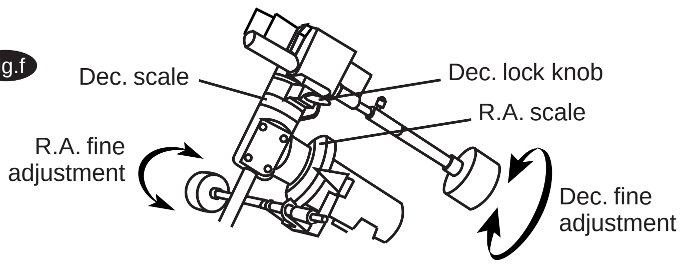
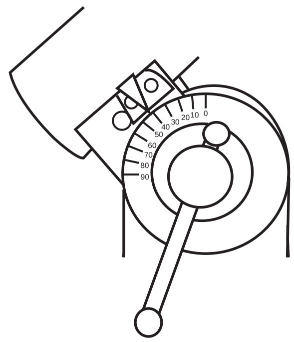



Fig.g



# Polar Alignment (for all models)

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 beginning.

**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.i). Unlock the hinge of the mount by gently pulling on the lock lever counter-clockwise. At the bottom of the head is a screw that pushes on a tongue under the hinge, changing the angle. Spin this until your latitude is shown on the scale by the indicator pin, then lock the hinge (Fig.h).

**Finding Polaris**

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.i).

**Alligning your telescope to Polaris**

Unlock the DEC lock knob and rotate the telescope tube until the pointer on the DEC setting circle reads 90˚. Retighten the DEC lock knob. Move the tripod so that the mount faces north and the R.A. axis points roughly at Polaris. A hand campass is useful for this step. Unlock the azimuth adjustment knob located underneath the mount

Fig.h

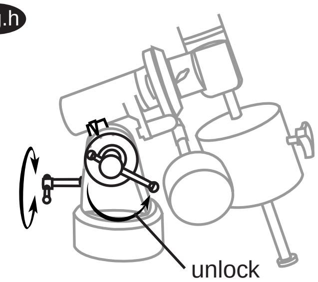
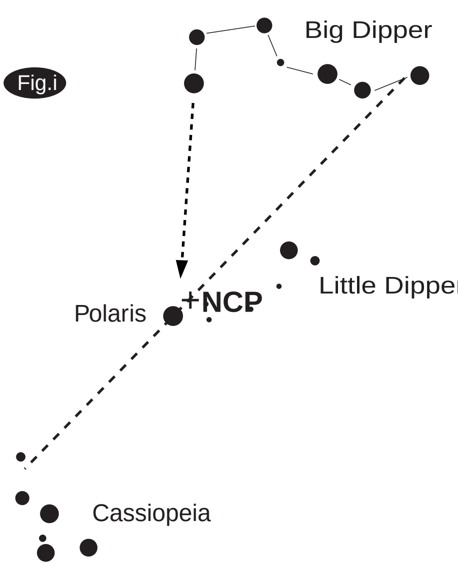



Fig.i



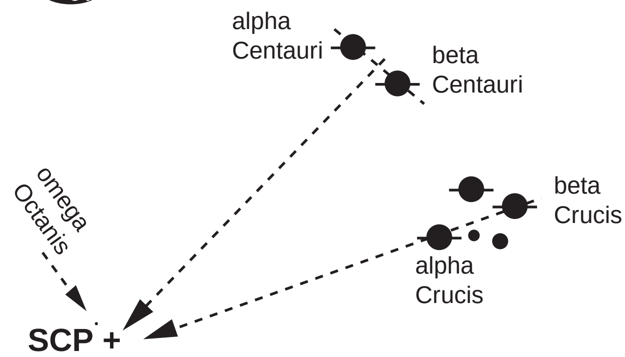
allignment, look through the finderscope and center the Polaris on the crosshairs.

Even though the true celestial pole may be up to twice the moon's diameter away (Polaris circles the pole once a day) you won't find this a problem unless you are doing long exposure photography.

**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.j).

Fig.j

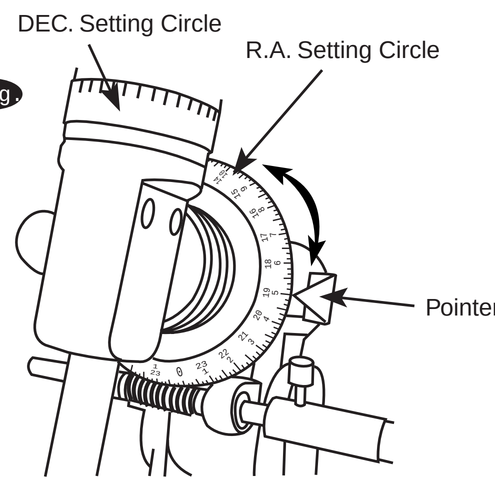



## Tracking Celestial Objects (for all models)

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, you only need to turn the R.A. slow-motion to follow or track objects as they move through the field. The DEC. slow-motion control is not needed for tracking. A R.A. motor drive can be added to automatically track celestial objects by counteracting the rotation of the Earth.

## Using the setting circles (for all models)

Fig.




The quickest way to find objects is to learn the Constellations and use the Red Dot Finder, but if the object is too faint you may want to use setting circles on your EQ1 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. The DEC. setting circle was set at the factory, and does not require calibrating the same manner as the R.A. setting circle.

**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.j).

**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.

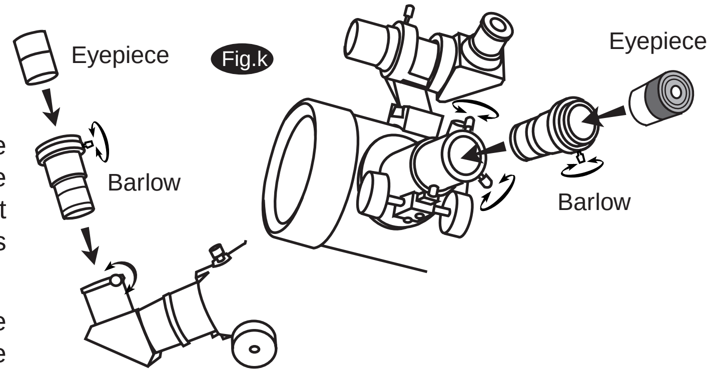
**Finding objects using the setting circles**

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

From a star chart, we know the coordinates of the Rings 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.

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/finderscope's field of view. The accuracy of your setting circles also depends on how accurate your telescope is polar aligned.

## Using the Barlow lens (for all models)




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, and usually between the diagonal and the eyepiece in a refractor or a catadioptric (Fig.k). With some telescopes, it can also be inserted between the focuser and the diagonal, and in this position it gives even greater magnification. For example, a Barlow which is 2X when inserted after the diagonal can become 3X when placed in front of the diagonal.

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, it is greatest value may be that a Barlow can potentially double the number of eyepiece in your collection.

# Choosing the appropriate eyepiece (for all models)

**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.

# OBSERVING THE SKY

## 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.

## Finding objects in the sky

The sky is mapped out in a spherical coordinate system similar to the system of Latitude and Longitude on the surface of the Earth. On the imaginary celestial sphere, the coordinates are Declination, which is equivalent to Latitude and measured in degrees, and Right Ascension, which is equivalent to Longitude, but measured in hours. The celestial equator is a projection of the Earth's equator onto the celestial sphere. Because the positions of stars and other distance celestial objects, as plotted on this celestial sphere, change very slowly with time, their listed coordinates and star charts are only updated every fifty years. On the other hand, planets change position so rapidly that their coordinates must be obtained from current astronomy periodicals. The setting circles on your equatorial mount can be aligned with the celestial sphere to aid in finding astronomical objects.

# TECHNICAL SPECIFICATIONS

| | SK 76/300 EQ/TA | SK 80/350 EQ/TA |
|---|---|---|
| **Optical Design** | Newtonian Reflector | Refractor |
| **Diameter** | 76mm | 80mm |
| **Focal Length** | 300mm | 350mm |
| **F/ratio** | f/4 | f/4.4 |
| **Highest Practical Power** | 152X | 160X |
| **Eyepiece Magnification** | 30X (10mm), 83X (3.6mm) | 17.5X (20mm), 97X (3.6mm) |
| **Faintest Steller Magnitude** | 12 | 12.2 |
| **Resolving Power (arc sec.)** | 1.5 | 1.45 |
| **Finderscope** | 5x24 (90˚) | Red Dot Finder |
| **Barrell Diameter** | 1.25" | 1.25" |
| **Mount Type** | Equatorial | Equatorial |
| **Tripod** | Table Top | Table Top |
| **Tube Dimension** | 10cm x 27cm | 10cm x 30.5cm |
| **Eyepieces** | Super 10mm, Super 3.6mm | Super 20mm, Super 3.6mm |
| **Diagonal** | No | 90˚ |
| **Barlow** | 2X | 2X |

| | SK 80/400 EQ/TA | SK MAK90 EQ/TA |
|---|---|---|
| **Optical Design** | Refractor | Maksutov |
| **Diameter** | 80mm | 90mm |
| **Focal Length** | 400mm | 1250mm |
| **F/ratio** | f/5 | f/13.8 |
| **Highest Practical Power** | 160X | 180X |
| **Eyepiece Magnification** | 20X (20mm), 111X (3.6mm) | 50X (25mm), 125X (10mm) |
| **Faintest Steller Magnitude** | 12.2 | 12.5 |
| **Resolving Power (arc sec.)** | 1.45 | 1.3 |
| **Finderscope** | Red Dot Finder | Red Dot Finder |
| **Barrell Diameter** | 1.25" | 1.25" |
| **Mount Type** | Equatorial | Equatorial |
| **Tripod** | Table Top | Table Top |
| **Tube Dimension** | 10cm x 38cm | 10cm x 23cm |
| **Eyepieces** | Super 20mm, Super 3.6mm | Super 25mm, Super 10mm |
| **Diagonal** | 90˚ | 90˚ |
| **Barlow** | 2X | 2X |

# TECHNICAL SUPPORT

www.SkywatcherTelescope.com

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E-mail: support@skywatchertelescope.com
Outside Canada: Please contact your dealer for technical support.