

# INSTRUCTION MANUAL

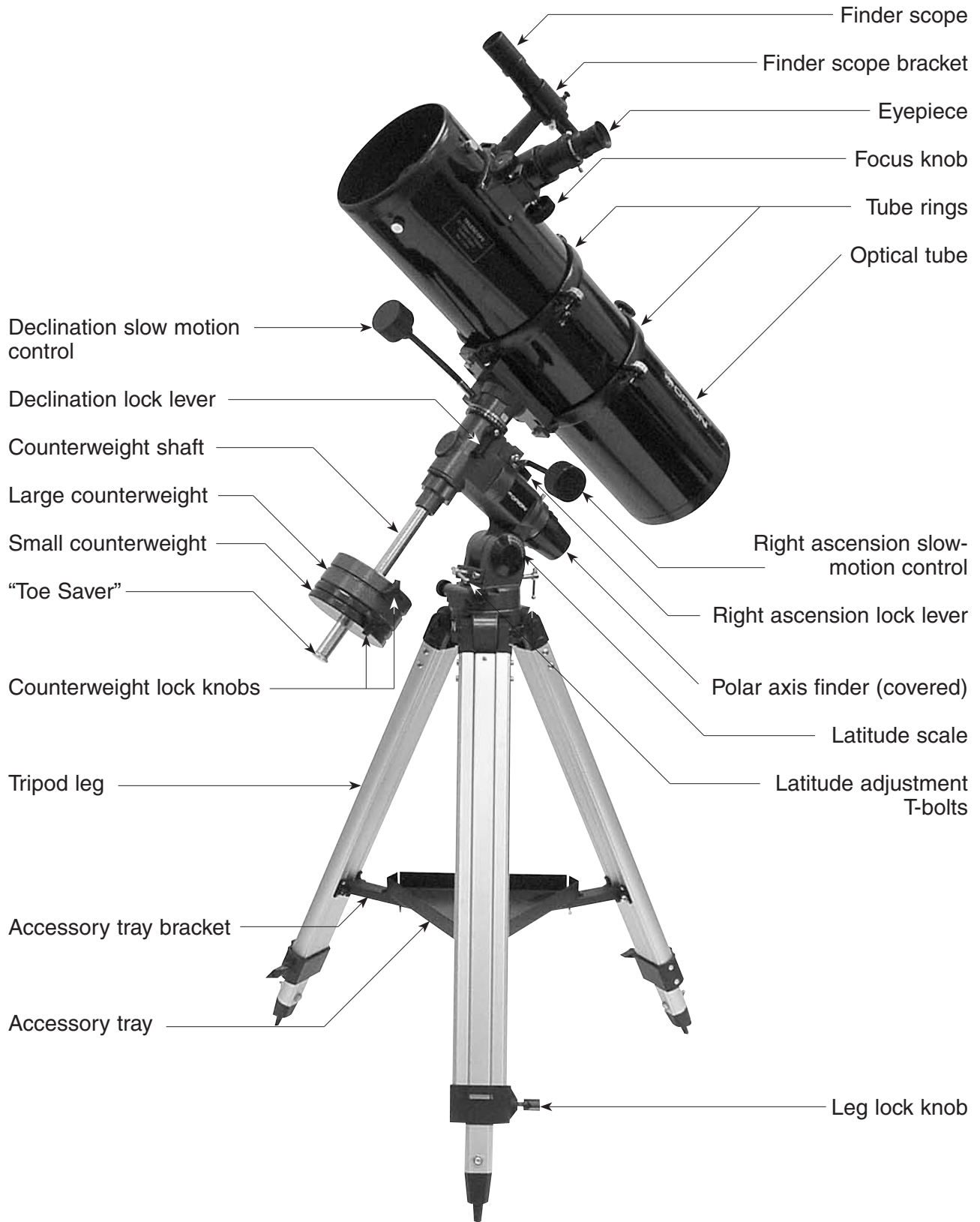
# Orion<sup>®</sup> AstroView<sup>™</sup> 6 EQ

**#9827 Equatorial Reflecting Telescope**



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**89 Hangar Way, Watsonville, CA 95076**



**Figure 1.** The AstroView 6 EQ

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Welcome to the exciting world of amateur astronomy! Your new AstroView 6 EQ Reflector is designed for high-resolution viewing of astronomical objects. With its precision optics and equatorial mount, you'll be able to locate and enjoy hundreds of fascinating celestial denizens, including the planets, Moon, and a variety of deep-sky galaxies, nebulas, and star clusters.

These instructions will help you set up, properly use, and care for your telescope. Please read them thoroughly before getting started.

## Table of Contents

1. Parts List . . . . .	3
2. Assembly . . . . .	3
3. Using Your Telescope . . . . .	5
4. Setting Up and Using the Equatorial Mount . . . . .	7
5. Collimation (Aligning the Mirrors) . . . . .	11
6. Astronomical Observing . . . . .	13
7. Astrophotography . . . . .	16
8. Care and Maintenance . . . . .	17
9. Specifications . . . . .	18

## 1. Parts List

- 1 Optical tube assembly
- 1 German type equatorial mount
- 1 Counterweight shaft
- 1 Large counterweight
- 1 Small counterweight
- 3 Tripod legs with accessory tray bracket attached
- 3 Leg attachment screws with wingnuts and washers
- 3 Leg lock knobs
- 1 Accessory tray with mounting hardware
- 2 Slow-motion control cables
- 1 Polar axis finder scope
- 1 Plastic cover for polar axis finder scope
- 2 Optical tube mounting rings (one with piggyback mount)
- 1 6x30 achromatic crosshair finder scope
- 1 Finder scope bracket with O-ring
- 1 25mm Sirius Plössl eyepiece
- 1 10mm Sirius Plössl eyepiece
- 1 Dust cap
- 1 Collimation cap
- 4 Assembly tools (2 wrenches, Phillips screwdriver, flat-head screwdriver key)

## 2. Assembly

After opening the box your telescope came in, make sure all the parts listed in part 1 are present and familiarize yourself with their features. Please keep the original shipping box and interior packaging! In the unlikely event that you should need to ship the original telescope back to Orion for warranty repair service, you must use the original packaging.

Assembling the telescope for the first time should take about 30 minutes. No tools are needed other than the ones provided. All bolts should be tightened securely to eliminate flexing and wobbling, but be careful not to over-tighten or the threads may strip. Refer to Figure 1 during the assembly process.

During assembly (and anytime, for that matter), DO NOT touch the surfaces of the telescope mirrors, the lenses of the finder scope or eyepieces with your fingers. The optical surfaces have delicate coatings on them that can easily be damaged if touched inappropriately.

1. Lay the equatorial mount on its side. Attach the tripod legs one at a time to the mount using the leg attachment screws. Line up the holes in the top of the leg with the holes in the base of the mount, and insert the screw so it passes through the leg and the mount. Tighten the wingnuts only finger-tight, for now. The washers go between the screw's head and the leg, and between the wingnut and the leg.

2. Insert and tighten the leg lock knobs into the base of the tripod legs. For now, keep the legs at their shortest (fully retracted) length; you can extend them to a more desirable length later, after the scope is completely assembled.

3. With the tripod legs now attached to the equatorial mount, stand the tripod upright (be careful!) and spread the legs apart as far as they will go, until the accessory tray bracket is taut.

4. Attach the accessory tray to the bracket with the three wingnut-head screws already installed in the tray. Push the screws up through the holes in the bracket, then thread them into the holes in the tray.

**WARNING:** *Never look directly at the Sun through your telescope or its finder scope—even for an instant—without a professionally made solar filter that completely covers the front of the instrument, or permanent eye damage could result. Young children should use this telescope only with adult supervision.*

5. Next, tighten the wingnuts at the top of the tripod legs, so the legs are securely fastened to the equatorial mount. Use the larger wrench and your fingers to do this.

6. Orient the equatorial mount as it appears in Figure 1, at a latitude of about 40°, i.e., so the pointer next to the latitude scale is pointing to the line at "40". To do this, loosen one of the latitude adjustment T-bolts and then tighten the other latitude adjustment T-bolt until the pointer and the "40" line up. The declination (Dec.) and right ascension (R.A.) axes may need re-positioning (rotation) as well. Be sure to loosen the RA and Dec. lock levers before doing this. Retighten them once the equatorial mount is properly oriented.

7. Thread the counterweight shaft into the equatorial mount at the base of the declination axis until tight. Make sure the casting at the top of the bar is threaded clockwise as far as it will go before attaching the shaft.

8. Remove the knurled "toe saver" retaining screw on the bottom of the counterweight shaft and slide both counterweights onto the shaft. Make sure the counterweight lock knobs are adequately loosened so the metal pin inside the counterweight is recessed enough to allow the counterweight shaft to pass through the hole. Position the counterweights about halfway up the shaft and tighten the lock knobs. Replace the toe saver on the end of the bar. The toe saver prevents the counterweights from falling on your foot if the lock knobs happen to come loose.

9. Attach the two tube rings to the equatorial head using the hex head screws that come installed in the rings. Remove the screws, then push them, with the washers still attached, up through the holes in the top of the equatorial mount and rethread them into the bottom of the tube rings. Tighten the screws securely with the smaller wrench. Open the tube rings by loosening the knurled ring clamps.

10. Lay the telescope optical tube in the tube rings at about the midpoint of the tube's length. Rotate the tube in the rings until the focuser is at a convenient level for you to view. Close the rings over the tube and tighten the knurled ring clamps finger-tight to secure the telescope in position.

11. Now attach the two slow-motion control cables to the R.A. and Dec. worm gear shafts of the equatorial mount by positioning the small screw on the end of the cable over the indented slot on the worm gear shaft. Then tighten the screw. Use the short slow-motion control for the R.A. axis; it will stick out sideways from the mount. The longer slow-motion control is for the Dec. axis; attach it to the Dec. worm gear shaft so that it extends toward the front of the optical tube as shown in Figure 1.

12. Install the polar axis finder scope into its housing inside the R.A. axis of the equatorial mount. First loosen the three thumbscrews on the housing, which is located at the rear of the R.A. axis (see Figures 5 and 8). Insert the front end of the polar finder (the end without the eyeguard) into the housing so only about 1" of the polar finder extends from the back of the housing. Do this slowly and with a twisting motion to prevent the internal O-ring from becoming unseated. If it does become unseated, you can remove the entire housing from the mount

to locate the O-ring and reseat it. This is done by rotating the entire housing counterclockwise. Once the polar axis finder scope is in the housing, tighten the three thumbscrews. These thumbscrews will be used later to align the finder with the mount's R.A. axis.

### Installing the Finder Scope

To place the finder scope in the finder scope bracket, first unthread the two black nylon screws until the screw ends are flush with the inside diameter of the bracket. Place the O-ring that comes on the base of the bracket over the body of the finder scope until it seats into the slot on the middle of the finder scope. Slide the eyepiece end (narrow end) of the finder scope into the end of the bracket's cylinder that does not have the adjustment screws while pulling the chrome, spring-loaded tensioner on the bracket with your fingers (Figure 2b). Push the finder scope through the bracket until the O-ring seats just inside the front opening of the bracket cylinder. Now, release the tensioner and tighten the two black nylon screws a couple of turns each to secure the finder scope in place. Insert the base of the finder scope bracket into the dovetail holder on the

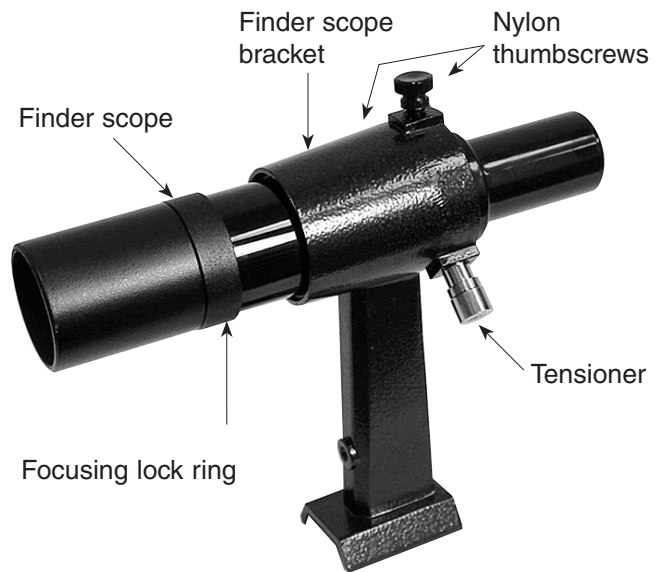


Figure 2a: The 6x26 Correct-Image finder scope



Figure 2b:

Pull-back on the tensioner and slide the finder scope into its bracket until the O-ring is seated in the bracket ring

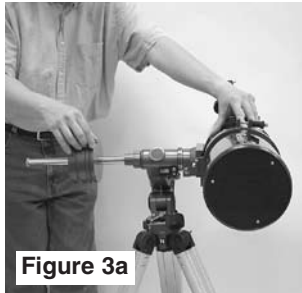


Figure 3a



Figure 3b



Figure 3c

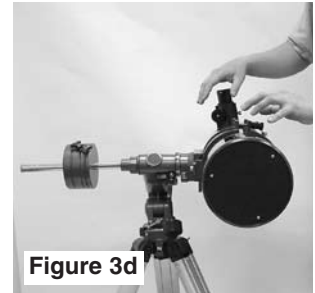


Figure 3d

**Figure 3a, b, c, d:** Proper operation of the equatorial mount requires that the telescope tube be balanced on both the R.A. and Dec. axes. (a) With the R.A. lock lever released, slide the counterweight along the counterweight shaft until it just counterbalances the tube. (b) When you let go with both hands, the tube should not drift up or

top of the focuser. Lock the bracket into position by tightening the knurled thumbscrew on the dovetail slot.

### Inserting the Eyepiece

Loosen the thumbscrews on the eyepiece holder and remove the small dust cap. Then insert the 25mm eyepiece into the focuser and secure it with the thumbscrews.

Your telescope is now completely assembled and should appear as shown in Figure 1.

### Balancing the Telescope

To ensure smooth movement of the telescope on both axes of the equatorial mount, it is imperative that the optical tube is properly balanced. We will first balance the telescope with respect to the R.A. axis, then the Dec. axis.

1. Keeping one hand on the telescope optical tube, loosen the R.A. lock lever. Make sure the Dec. lock lever is locked, for now. The telescope should now be able to rotate freely about the R.A. axis. Rotate it until the counterweight shaft is parallel to the ground (i.e., horizontal).
2. Now loosen both counterweight lock knobs and slide the weights along the shaft until they exactly counterbalance the telescope (Figure 3a). That's the point at which the shaft remains horizontal even when you let go with both hands (Figure 3b).
3. Retighten the counterweight lock knobs. The telescope is now balanced on the R.A. axis.
4. To balance the telescope on the Dec. axis, first tighten the R.A. lock lever, with the counterweight shaft still in the horizontal position.
5. With one hand on the telescope optical tube, loosen the Dec. lock lever. The telescope should now be able to rotate freely about the Dec. axis.
6. Loosen the tube ring clamps a few turns, until you can slide the telescope tube forward and back inside the rings. (this can be aided by using a slight twisting motion on the optical tube while you push or pull on it). (Figure 3c).
7. Position the telescope in the mounting rings so it remains horizontal when you carefully let go with both hands. This is

down. (c) With the Dec. lock lever released, loosen the tube ring clamps a few turns and slide the telescope forward or back in the tube rings. (d) when the tube is balanced about the Dec. axis, it will not move when you let go.

the balance point for the optical tube with respect to the Dec. axis (Figure 3d).

8. Retighten the tube ring clamps.

The telescope is now balanced on both axes. Now when you loosen the lock lever on one or both axes and manually point the telescope, it should move without resistance and should not drift from where you point it.

## 3. Using Your Telescope

### Focusing the Telescope

You should now try to familiarize yourself with focusing the telescope. First, insert the 25mm eyepiece in the focuser and point the telescope in the general direction of an object at least a 1/4 mile away. With your fingers, slowly rotate one of the focus knobs until the object comes into sharp focus. Go a little bit beyond sharp focus until the object starts to blur again, then reverse the direction of the knob, just to make sure you've hit the exact focus point.

**NOTE:** *The image in the telescope will appear rotated 180° (upside-down and reversed left-to-right). This is normal for astronomical scopes. The finder scope view will also be rotated 180°. (see Figure 4)*

If you have trouble focusing, rotate the focus knob so the draw-tube is in as far as it will go. Now look through the eyepiece while slowly rotating the focusing knob in the opposite direction. You should soon see the point at which focus is reached. You will have to re-adjust the focus when aiming at subjects of varying distances, or after changing eyepieces.

### Viewing with Eyeglasses

If you wear eyeglasses, you may be able to keep them on while you observe, if the eyepiece has enough "eye relief" to allow you to see the whole field of view. You can try this by looking through the eyepiece first with your glasses on, and then with them off, and see if the glasses restrict the view to only a portion of the full field. If they do, you can easily observe with your glasses off by just re-focusing the telescope the needed amount. If you suffer from severe astigmatism, however, you may find images noticeably sharper with your glasses on.





Naked-eye view



View through finder scope and telescope

**Figure 4.** The view through a standard finder scope and reflector telescope is rotated 180°. This is true for the AstroView 6 and its finder scope as well.

### Aligning the Finder Scope

The AstroView 6 EQ comes with a 6x30 achromatic finder scope (Figure 2a). The number 6 means six-times magnification and the 30 indicates a 30mm diameter front lens. The finder scope makes it easier to locate the subject you want to observe in the telescope, because the finder scope has a much wider field-of-view.

The AstroView 6 EQ's finder scope uses a spring-loaded bracket that makes alignment of the finderscope very easy. As you turn either of the thumbscrews, the spring in the bracket's tensioner moves in and out to keep the finder scope secure in the bracket.

The finder scope must be aligned accurately with the telescope for proper use. To align it, first aim the main telescope in the general direction of an object at least a 1/4 mile away—the top of a telephone pole, a chimney, etc. To aim the telescope, loosen the R.A. and Dec. lock levers and move it until it is pointing at the desired object. To help in aiming the telescope, put your eye next to the tube and sight along the length of the optical tube. This will give you a general idea of where the telescope is pointing. Then retighten the R.A. and Dec. lock levers. Turn the focus knob until the object is properly focused. Make sure to position the object in the center of the telescope's eyepiece by turning the R.A. and declination slow-motion controls.

Now look in the finder scope. Is the object visible? Ideally it will be somewhere in the field of view. If not, some coarse adjustment to the finder scope bracket's thumbscrews will be needed until the object comes into the finder scope's field of view.

With the image in the finder scope's field of view, you will now need to fine-adjust the alignment thumbscrews to center the object on the intersection of the crosshairs. Adjust the aim of the finder scope by turning the thumbscrews, one at a time, until the object is centered.

The finder scope alignment needs to be checked before every observing session. This can easily be done at night, before viewing through the telescope. Choose any bright star or planet, center the object in telescope eyepiece, and then

adjust the finder scope bracket's alignment thumbscrews until the star or planet is centered on the finder's crosshairs.

### Focusing the finder scope

If, when you look through the finder scope, the images appear somewhat out of focus, you will need to refocus the finder scope for your eyes. Loosen the lock ring located behind the objective lens cell on the body of the finder scope (see Figure 2a). Back the lock ring off by a few turns, for now. Refocus the finder scope on a distant object by threading the objective lens cell in or out of the finderscope body. Precise focusing will be achieved by focusing the finder scope on a bright star. Once the image appears sharp, retighten the locking ring behind the objective lens cell. The finder scope's focus should not need to be adjusted again.

### Magnification & Eyepieces

Magnification, or power, is determined by the focal length of the telescope and the focal length of the eyepiece. Therefore, by using eyepieces of different focal lengths, the resultant magnification can be varied.

Magnification is calculated as follows:

$$\text{Magnification} = \frac{\text{Telescope Focal Length (mm)}}{\text{Eyepiece Focal Length (mm)}}$$

The AstroView 6 EQ has a focal length of 750mm, which when used with the supplied 25mm eyepiece yields:

$$750\text{mm} \div 25\text{mm} = 30\text{x}$$

The magnification provided by the 10mm eyepiece is:

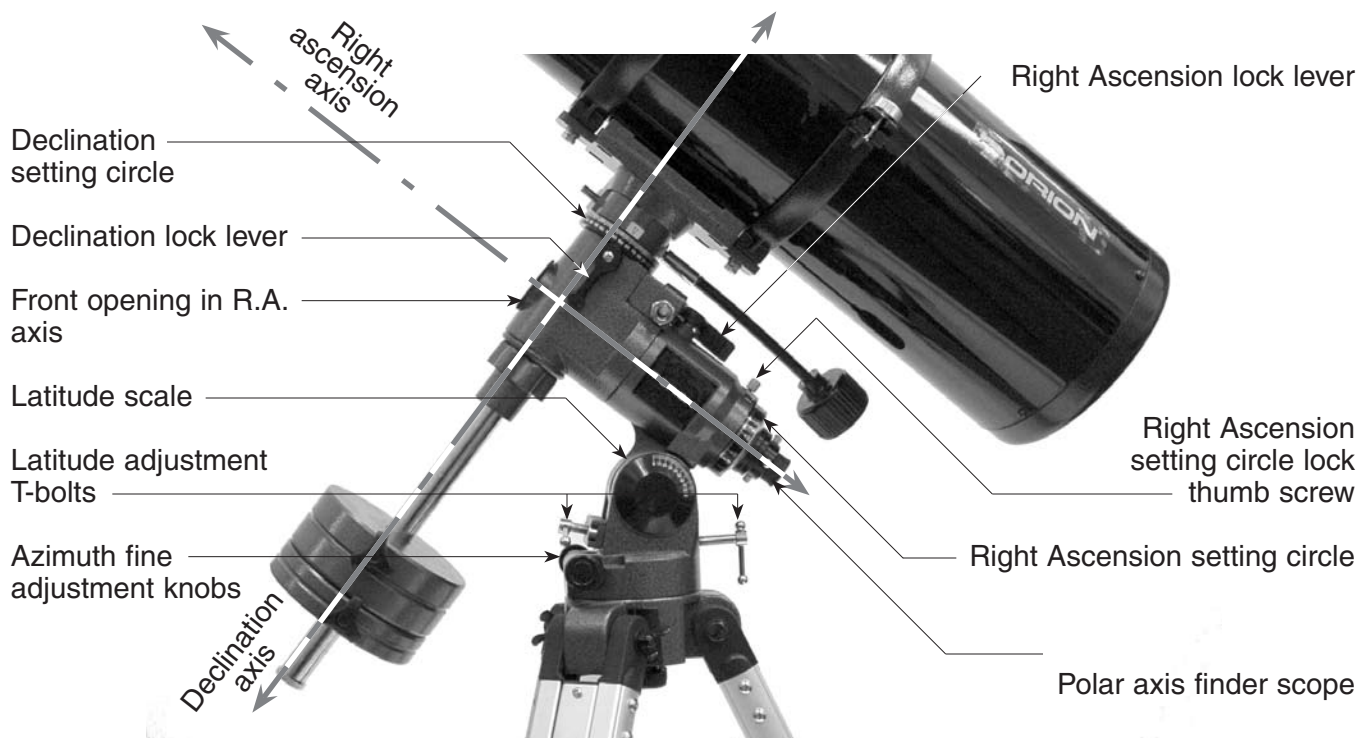
$$750\text{mm} \div 10\text{mm} = 75\text{x}$$

The maximum attainable magnification for a telescope is directly related to how much light it can gather. The larger the aperture, the more magnification is possible. In general a figure of 50x per inch of aperture is the maximum attainable for most telescopes. Your AstroView 6 EQ has an aperture of 6 inches, so the maximum magnification is about 300x. This level of magnification assumes you have ideal conditions for viewing.

Keep in mind that as you increase magnification, the brightness of the object viewed will decrease; this is an inherent principle of the laws of physics and cannot be avoided. If magnification is doubled, an image appears four times dimmer. If magnification is tripled, image brightness is reduced by a factor of nine!

Always start with your lowest power eyepiece and work your way up.

Start by centering the object being viewed in the 25mm eyepiece. Then, you may want to increase the magnification to get a closer view. Before changing eyepieces, make sure the object being viewed is centered in the eyepiece field of view. If the object is off-center (i.e., it is near the edge of the field of view) you will lose it when you increase magnification since the field of view will be narrower with the higher-powered eyepiece. To change eyepieces, first loosen the thumbscrews on



**Figure 5:** The equatorial mount of the AstroView 6

the focuser. Then carefully lift the eyepiece out of the holder. Do not tug or pull the eyepiece to the side, as this will knock the telescope off its target. Replace the eyepiece with the new one by sliding it gently into the holder. Re-tighten the thumb-screws, and focus for your new magnification.

## 4. Setting Up and Using the Equatorial Mount

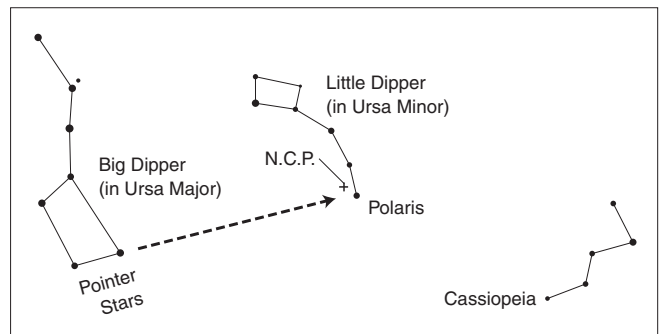
When you look at the night sky, you no doubt have noticed that the stars appear to move slowly from east to west over time. That apparent motion is caused by the Earth's rotation (from west to east). An equatorial mount (Figure 5) is designed to compensate for that motion, allowing you to easily "track" the movement of astronomical objects, thereby keeping them from drifting out of the telescope's field of view while you're observing.

This is accomplished by slowly rotating the telescope on its right ascension (R.A.) axis, using only the R.A. slow-motion cable. But first the R.A. axis of the mount must be aligned with the Earth's rotational (polar) axis—a process called polar alignment.

### Polar Alignment

For Northern Hemisphere observers, approximate polar alignment is achieved by pointing the mount's R.A. axis at the North Star, or Polaris. It lies within 1° of the north celestial pole (NCP), which is an extension of the Earth's rotational axis out into space. Stars in the Northern Hemisphere appear to revolve around Polaris.

To find Polaris in the sky, look north and locate the pattern of the Big Dipper (Figure 6). The two stars at the end of the

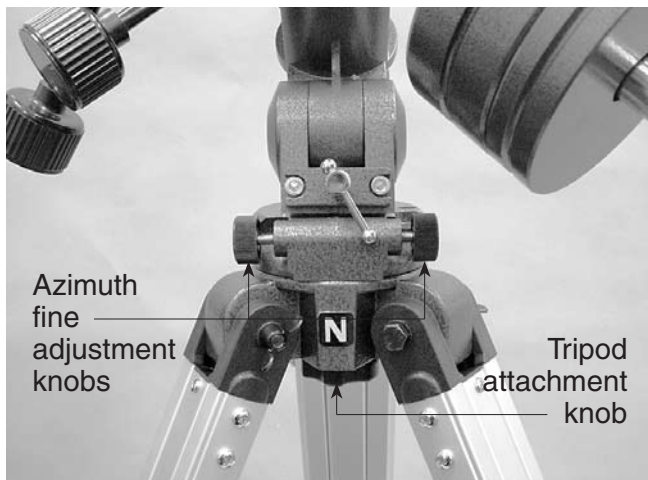


**Figure 6.** To find Polaris in the night sky, look north and find the Big Dipper. Extend an imaginary line from the two "Pointer Stars" in the bowl of the Big Dipper. Go about five times the distance between those stars and you'll reach Polaris, which lies within 1° of the north celestial pole (NCP).

"bowl" of the Big Dipper point right to Polaris. Observers in the Southern Hemisphere aren't so fortunate to have a bright star so near the south celestial pole (SCP). The star Sigma Octantis lies about 1° from the SCP, but it is barely visible with the naked eye (magnitude 5.5).

For general visual observation, an approximate polar alignment is sufficient:

1. Level the equatorial mount by adjusting the length of the three tripod legs.
2. Loosen one of the latitude adjusting T-bolts and tighten the other to tilt the mount until the pointer on the latitude scale is set at the latitude of your observing site. If you don't know your latitude, consult a geographical atlas to find it. For example, if



**Figure 7.** For polar alignment, position the tripod so that the “N” label at the base of the mount faces north. The two azimuth fine adjustment knobs above it are used to make small adjustments to the mount’s azimuth position.

your latitude is 35° North, set the pointer to +35. The latitude setting should not have to be adjusted again unless you move to a different viewing location some distance away.

**3.** Loosen the Dec. lock lever and rotate the telescope optical tube until it is parallel with the R.A. axis. The pointer on the Dec. setting circle should read 90°. Retighten the Dec. lock lever.

**4.** Move the tripod so the telescope tube (and R.A. axis) points roughly at Polaris. If you cannot see Polaris directly from your observing site, consult a compass and rotate the tripod so the telescope points north. There is a label bearing a large “N” at the base of the equatorial mount (Figure 7). It should be facing north.

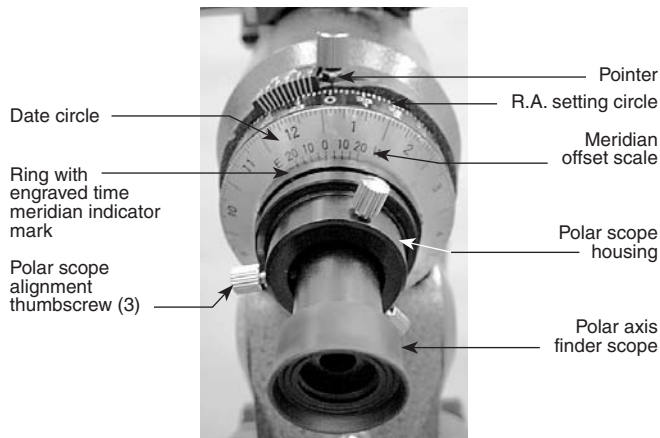
The equatorial mount is now approximately polar-aligned for casual observing. More precise polar alignment is required for astrophotography and for use of the manual setting circles.

From this point on in your observing session, you should not make any further adjustments to the latitude of the mount, nor should you move the tripod. Doing so will undo the polar alignment. The telescope should be moved only about its R.A. and Dec. axes.

### The Polar Axis Finder Scope

A feature of the AstroView 6 EQ is the polar axis finder scope housed inside the R.A. axis of the equatorial mount (see Figure 8). When properly aligned and used, it makes accurate polar alignment quick and easy to do. Alignment of the polar finder need only be done once, unless it gets bumped or otherwise shifts its position.

Remove the cover cap from the front opening in the R.A. axis of the mount (see Figure 5). Look through the polar finder at a distant object. Focus the polar finder so that the images and reticle are sharp by rotating the eyepiece end of the finder. Notice that the reticle pattern consists of a crosshair with a circle around the middle. On the circumference of this circle



**Figure 8.** The polar axis finder scope installed in the right ascension (R.A.) axis of the mount.

is a tiny circle; this is where Polaris will be placed for accurate polar alignment once the finder is properly aligned. Alignment of the polar finder is best done during the day, before going out into the field at night.

### Aligning the Polar Axis Finder Scope

Aligning the polar axis finder scope so that it will accurately point at the true north pole is a two-step procedure. First, the polar finder must be rotated in its housing so that the small circle in which Polaris will be placed in is in the proper initial position. Next, the polar axis finder must be adjusted so that it points directly along the mount’s R.A. axis.

We will start by aligning the polar finder rotationally. Refer to Figure 8.

**1.** Loosen the R.A. setting circle lock thumb screw, located just above the R.A. setting circle (see Figure 5). Rotate the R.A. setting circle until the line above the “0” on the setting circle lines up with the pointed indicator that is cast into the mount (located directly below the large thumbscrew; see Figure 8). Retighten the thumbscrew.

**2.** Rotate the date circle until the “0” line on the meridian offset scale lines up with the time meridian indicator mark. The meridian offset scale is printed on the inner circumference of the date circle, and is labeled “E20” to “W20”. The time meridian indicator mark is an engraved line on the exterior of the polar finder’s housing. It is on the “ring” of the housing that is closest to the date circle.

**3.** The R.A. setting circle is labeled in hours, from “0” to “23” (military time). For Northern Hemisphere observers, refer to the top numbers on the setting circle. Each small line represents 10 minutes of R.A. The date circle is labeled from “1” to “12”, with each number representing a month of the year (“1” is January, “2” is February, etc.). Each small line represents a two-day increment.



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4. Loosen the R.A. lock lever and rotate the mount about the R.A. axis until the March 1 indicating mark (the long line between the “2” and the “3”) on the date circle lines up with the 4 PM mark (the long line above the “16”) on the R.A. setting circle. You may find it convenient to remove both the counterweights and the telescope optical tube to do this.

5. Now, loosen the three thumbscrews on the polar finder housing and rotate the polar finder so the small circle where Polaris will be centered is located straight down from the intersection of the crosshairs. Retighten the thumbscrews.

The polar axis finder scope is now properly set in its initial position. Next, you must align it so that it is exactly parallel to the mount’s R.A. axis:

6. Look through the polar finder at a distant object (during the day) and center it in the crosshairs. You may need to adjust the latitude adjustment T-bolts and the tripod position to do this.

7. Rotate the mount 180° about the R.A. axis. Again, it may be convenient to remove the counterweights and optical tube first.

8. Look through the polar finder again. Is the object being viewed still centered on the crosshairs? If it is, then no further adjustment is necessary. If not, then look through the polar finder while rotating the mount about the R.A. axis. You will notice that the object you have previously centered moves in a circular path. Use the three thumbscrews on the housing to redirect the crosshairs of the polar finder to the apparent center of this circular path. Repeat this procedure until the position that the crosshairs point to does not rotate off-center when the mount is rotated in R.A. Once this is accomplished, retighten the thumbscrews.

The polar axis finder scope is now ready to be used. When not in use, replace the plastic protective cover to prevent the polar finder from getting bumped, which could knock it out of alignment.

### Using the Polar Axis Finder

When using the polar finder in the field at night, you will need a red flashlight to illuminate the finder’s reticle. Shine the flashlight at an angle into the front opening in the R.A. axis. Do not shine it directly into the opening, or the light will be too bright, and you will also obstruct the view of the polar finder. It may be helpful to have a friend hold the flashlight while you look through the polar finder.

For most accurate polar alignment, you will need to know the approximate longitude of your observing site. This information can be obtained by looking at a local map. Now, figure the difference between the longitude of your observing site and the closest standard time meridian. The standard time meridians are 75°, 90°, 105°, and 120° for the 48 continental states (150° and 165° for Hawaii and Alaska). Choose the standard time meridian that is closest in value to your local longitude, and then calculate the difference. If your local longitude has a value less than the closest standard time meridian, you are east of the standard time meridian by the calculated amount. If your local longitude has a value greater than the closest

standard time meridian, you are west of the standard time meridian by the calculated amount. For example, if you are in Las Vegas, which has a longitude of 115°, the closest standard time meridian is 120°. The difference between these two numbers is 5°. Since Las Vegas’ longitude value is less than the standard time meridian value, you are 5° east of the closest time meridian.

Take your calculated difference from the closest standard time meridian and rotate the date circle so that the meridian offset scale line that corresponds to your calculated difference lines up with the engraved time meridian indicator mark on the polar finder housing. Each line of the meridian offset scale represents 5° of longitude. Lines to the left of the “0” on the meridian offset scale indicate east of the closest standard time meridian, while lines to the right of the “0” indicate west of the closest standard time meridian.

Continuing with the prior example of observing in Las Vegas, you would rotate the date circle so that the first line to the left of the “0” on the meridian offset scale lines up with the time meridian indicator mark.

Make sure that the “0” mark on the R.A. setting circle lines up with the pointed indicator cast into the mount, and that the large thumbscrew just above it is tightened. Now, rotate the mount about the R.A. axis of the mount until the line on the R.A. setting circle that corresponds to your current local time lines up with the line on the date circle that indicates the current date. If you are on daylight savings time, subtract one hour from your current local time. For example, if it was November 1 at 9 PM, standard time, you would rotate the telescope in R.A. until the line above the “21” (9 P.M.) on the R.A. setting circle lines up with the long line between the “10” and “11” on the date circle. The long line indicates the first day of the higher numbered month, i.e. the line between “10” and “11” marks November 1st.

Finally, look through the polar alignment finder scope while shining a red flashlight at an angle down the front opening of the R.A. axis, and center Polaris in the small circle. Adjust the tilt of the altitude up-or-down with the latitude adjustment T-bolts and use the azimuth fine adjustment knobs (Figure 7) for final positioning. To do this, you will first need to loosen the big tripod attachment knob directly underneath the base of the equatorial mount. The fine adjustment knobs work by loosening one and then tightening the other. When done, retighten the tripod attachment knob to firmly secure the mount and tripod. If the fine adjustment knobs do not allow the mount to move far enough to center Polaris, you will need to rotate the entire tripod left or right to get it within the fine adjustment’s range.

Once Polaris is centered in the small circle, you are done. The telescope is now accurately polar aligned, and can be used for advanced observational applications, such as astrophotography or precise use of the manual setting circles. As mentioned before, only move the telescope along the R.A. and Dec. axes; if you move the tripod, or change the tilt of the equatorial mount, you will need to polar align again.

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Remember, accurate polar alignment is not needed for casual visual observing. Most of the time, approximate polar alignment, as outlined previously, will suffice.

### Tracking Celestial Objects

When you observe a celestial object through the telescope, you'll see it drift slowly across the field of view. To keep it in the field, if your equatorial mount is polar-aligned, just turn the R.A. slow-motion control. The Dec. slow-motion control is not needed for tracking. Objects will appear to move faster at higher magnifications, because the field of view is narrower.

### Optional Motor Drive

An optional DC motor drive system can be mounted on the AstroView's equatorial mount to provide hands-free tracking. Objects will then remain stationary in the field of view without any manual adjustment of the R.A. slow-motion control. The motor drive system is necessary for astrophotography.

### Understanding the Setting Circles

The setting circles on an equatorial mount enable you to locate celestial objects by their "celestial coordinates". Every object resides in a specific location on the "celestial sphere". That location is denoted by two numbers: its right ascension (R.A.) and declination (Dec.). In the same way, every location on Earth can be described by its longitude and latitude. R.A. is similar to longitude on Earth, and Dec. is similar to latitude. The R.A. and Dec. values for celestial objects can be found in any star atlas or star catalog.

The R.A. setting circle is scaled in hours, from 1 through 24, with small marks in between representing 10 minute increments (there are 60 minutes in 1 hour of R.A.). The upper set of numbers apply to viewing in the Northern Hemisphere, while the numbers below them apply to viewing in the Southern Hemisphere.

The Dec. setting circle is scaled in degrees, with each mark representing 2° increments. Values of Dec. coordinates range from +90° to -90°. The 0° mark indicates the celestial equator. When the telescope is pointed north of the celestial equator, values of the Dec. setting circle are positive, while when the telescope is pointed south of the celestial equator, values of the Dec. setting circle are negative.

So, the coordinates for the Orion Nebula listed in a star atlas will look like this:

**R.A. 5h 35.4m Dec. -5° 27'**

That's 5 hours and 35.4 minutes in right ascension, and -5 degrees and 27 arc-minutes in declination (there are 60 arc-minutes in 1 degree of declination).

Before you can use the setting circles to locate objects, the mount must be well polar aligned, and the R.A. setting circle must be calibrated. The Dec. setting circle has been calibrated at the factory, and should read 90° whenever the telescope optical tube is parallel with the R.A. axis.

### Calibrating the Right Ascension Setting Circle

1. Identify a bright star in the sky near the celestial equator (Dec. = 0°) and look up its coordinates in a star atlas.
2. Loosen the R.A. and Dec. lock levers on the equatorial mount, so the telescope optical tube can move freely.
3. Point the telescope at the bright star whose coordinates you know. Lock the R.A. and Dec. lock levers. Center the star in the telescope's field of view with the slow-motion control cables.
4. Loosen the R.A. setting circle lock thumbscrew (see Figure 5); this will allow the setting circle to rotate freely. Rotate the setting circle until the arrow under the thumbscrew indicates the R.A. coordinate listed in the star atlas for the object. Do not retighten the thumbscrew when using the R.A. setting circles for finding objects; the thumbscrew is only needed for polar alignment using the polar axis finder scope.

### Finding Objects With the Setting Circles

Now that both setting circles are calibrated, look up in a star atlas the coordinates of an object you wish to view.

1. Loosen the Dec. lock lever and rotate the telescope until the Dec. value from the star atlas matches the reading on the Dec. setting circle. Remember that values of the Dec. setting circle are positive when the telescope is pointing north of the celestial equator (Dec. = 0°), and negative when the telescope is pointing south of the celestial equator. Retighten the lock lever.
2. Loosen the R.A. lock lever and rotate the telescope until the R.A. value from the star atlas matches the reading on the R.A. setting circle. Remember to use the upper set of numbers on the R.A. setting circle. Retighten the lock lever.

Most setting circles are not accurate enough to put an object dead-center in the telescope's eyepiece, but they should place the object somewhere within the field of view of the finder scope, assuming the equatorial mount is accurately polar aligned. Use the slow-motion controls to center the object in the finder scope, and it should appear in the telescope's field of view.

The R.A. setting circle must be re-calibrated every time you wish to locate a new object. Do so by calibrating the setting circle for the centered object before moving on to the next one.

### Confused About Pointing the Telescope?

Beginners occasionally experience some confusion about how to point the telescope overhead or in other directions. In Figure 1 the telescope is pointed north as it would be during polar alignment. The counterweight shaft is oriented downward. But it will not look like that when the telescope is pointed in other directions. Let's say you want to view an object that is directly overhead, at the zenith. How do you do it?

DO NOT make any adjustment to the latitude adjustment T-bolts. That will spoil the mount's polar alignment. Remember, once the mount is polar aligned, the telescope should be moved only on the R.A. and Dec. axes. To point the scope overhead, first loosen the R.A. lock lever and rotate the tele-

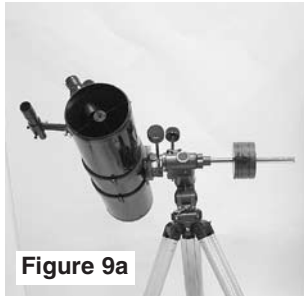


Figure 9a



Figure 9b



Figure 9c



Figure 9d

**Figure 9a,b,c,d:** This illustration shows the telescope pointed in the four cardinal directions: (a) North, (b) South, (c) East, (d) West.

scope on the R.A. axis until the counterweight shaft is horizontal (parallel to the ground). Then loosen the Dec. lock lever and rotate the telescope until it is pointing straight overhead. The counterweight shaft is still horizontal. Then retighten both lock levers.

What if you need to aim the telescope directly north, but at an object that is nearer to the horizon than Polaris? You can't do it with the counterweight down as pictured in Figure 1. Again, you have to rotate the scope in R.A. so that the counterweight shaft is positioned horizontally. Then rotate the scope in Dec. so it points to where you want it near the horizon.

To point the telescope directly south, the counterweight shaft should again be horizontal. Then you simply rotate the scope on the Dec. axis until it points in the south direction.

To point the telescope to the east or west, or in other directions, you rotate the telescope on its R.A. and Dec. axes. Depending on the altitude of the object you want to observe, the counterweight shaft will be oriented somewhere between vertical and horizontal.

Figure 9 illustrates how the telescope will look when pointed at the four cardinal directions: north, south, east and west.

The key things to remember when pointing the telescope are that a) you only move it in R.A. and Dec., not in azimuth or latitude (altitude), and b) the counterweight and shaft will not always appear as it does in Figure 1. In fact it almost never will!

## 5. Collimation (Aligning the Mirrors)

Collimation is the process of adjusting the mirrors so they are perfectly aligned with one another. Your telescope's optics were aligned at the factory, and should not need much adjustment unless the telescope is handled roughly. Accurate mirror alignment is important to ensure the peak performance of your telescope, so it should be checked regularly. Collimation is relatively easy to do and can be done in daylight.

To check collimation, remove the eyepiece and look down the focuser drawtube. You should see the secondary mirror centered in the drawtube, as well as the reflection of the primary mirror centered in the secondary mirror, and the reflection of

Note that the tripod and mount have not been moved; only the telescope tube has move on the R.A. and Dec. axis.

the secondary mirror (and your eye) centered in the reflection of the primary mirror, as in Figure 10a. If anything is off-center, as in Figure 10b, proceed with the following collimation procedure.

### The Collimation Cap and Mirror Center Mark

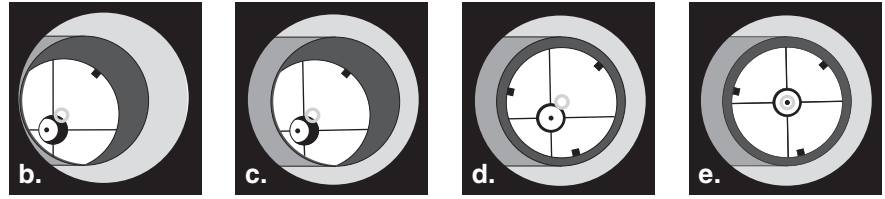
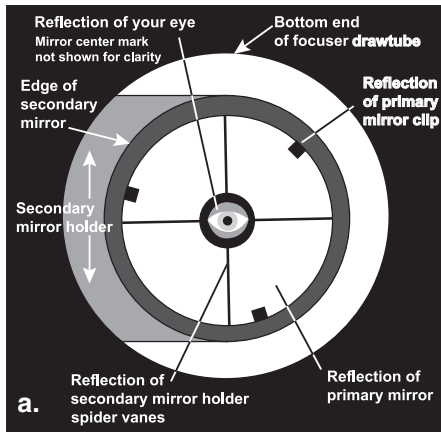
Your AstroView 6 EQ comes with a collimation cap. This is a simple cap that fits on the focuser drawtube like a dust cap, but has a hole in the center and a silver bottom. This helps center your eye so that collimation is easy to perform. Figures 10b through 10e assume you have the collimation cap in place.

In addition to the collimation cap, the primary mirror is marked with a circle at its exact center. This "center mark" allows you to achieve a precise collimation of the primary mirror; you don't have to guess where the center of the mirror is. You simply adjust the mirror position (described below) until the reflection of the hole in the collimation cap is centered in the ring. The center mark is also required for best results when using other collimating devices, such as Orion's LaserMate Collimator, obviating the need to remove the primary mirror and mark it yourself.

**Note: The center ring sticker need not ever be removed from the primary mirror. Because it lies directly in the shadow of the secondary mirror, its presence in no way adversely affects the optical performance of the telescope or the image quality. That might seem counterintuitive, but its true!**

### Aligning the Secondary Mirror

With the collimation cap in place, look through the hole in the cap at the secondary (diagonal) mirror. Ignore the reflections for the time being. The secondary mirror itself should be centered in the focuser drawtube, in the direction parallel to the length of the telescope. If it isn't, as in Figure 10b, it must be adjusted. Typically, this adjustment will rarely, if ever, need to be done. It helps to adjust the secondary mirror in a brightly lit room with the telescope pointed towards a bright surface, such as white paper or wall. Also placing a piece of white paper in the telescope tube opposite the focuser (in other words, on the other side of the secondary mirror) will also be helpful in collimating the secondary mirror. Using a 2mm Allen wrench, loosen the three small alignment set screws in the center hub of the 4-vaned spider several turns. Now hold the



**Figure 10.** Collimating the optics. (a) When the mirrors are properly aligned, the view down the focuser drawtube should look like this (b) With the collimation cap in place, if the optics are out of alignment, the view might look something like this. (c) Here, the secondary mirror is centered under the focuser, but it needs to be adjusted (tilted) so that the entire primary mirror is visible. (d) The secondary mirror is correctly aligned, but the primary mirror still needs adjustment. When the primary mirror is correctly aligned, the “dot” will be centered, as in (e).

mirror holder stationary (be careful not to touch the surface of the mirror), while turning the center screw with a Phillips head screwdriver (See Figure 11). Turning the screw clockwise will move the secondary mirror toward the front opening of the optical tube, while turning the screw counter-clockwise will move the secondary mirror toward the primary mirror.

**Note:** When making these adjustments, be careful not to stress the spider vanes or they may bend.

When the secondary mirror is centered in the focuser drawtube, rotate the secondary mirror holder until the reflection of the primary mirror is as centered in the secondary mirror as possible. It may not be perfectly centered, but that is OK. Now tighten the three small alignment screws equally to secure the secondary mirror in that position.

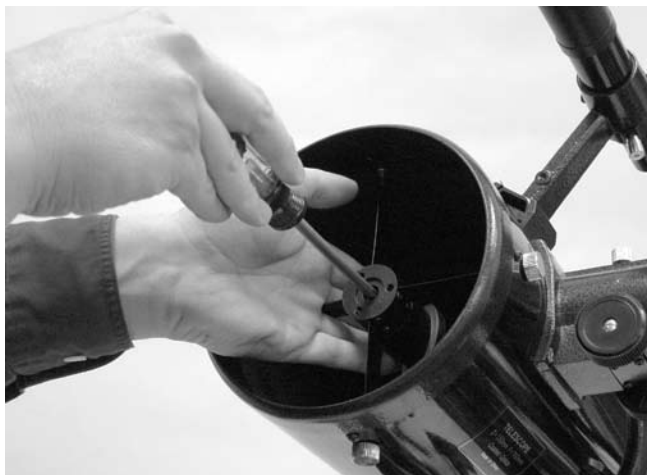
If the entire primary mirror reflection is not visible in the secondary mirror, as in Figure 10c; you will need to adjust the tilt of the secondary mirror. This is done by alternately loosening one of the three alignment set screws while tightening the other two, as depicted in Figure 12. The goal is to center the

primary mirror reflection in the secondary mirror, as in Figure 10d. Don't worry that the reflection of the secondary mirror (the smallest circle, with the collimation cap “dot” in the center) is off-center. You will fix that in the next step.

### Aligning the Primary Mirror

The final adjustment is made to the primary mirror. It will need adjustment if, as in Figure 10d, the secondary mirror is centered under the focuser and the reflection of the primary mirror is centered in the secondary mirror, but the small reflection of the secondary mirror (with the “dot” of the collimation cap) is off-center.

The tilt of the primary mirror is adjusted with three spring-loaded collimation thumbscrews on the back end of the optical tube (bottom of the primary mirror cell); these are the larger thumbscrews. The other three smaller thumbscrews lock the mirror's position in place; these thumbscrews must be loosened before any collimation adjustments can be made to the primary mirror.



**Figure 11:** To center the secondary mirror under the focuser, hold the secondary mirror holder in place with one hand while adjusting the center bolt with a Phillips screwdriver. Do not touch the mirror's surface. This adjustment will rarely need to be done.



**Figure 12:** Adjust the tilt of the secondary mirror by loosening or tightening the three alignment set screws with a 2mm Allen wrench.





**Figure 13:** The three small thumbscrews that lock the primary mirror in place must first be loosened before any adjustments can be made. A flat head screwdriver may be used to loosen these screws.

To start, turn the smaller thumbscrews that lock the primary mirror in place a few turns each (Figure 13). Use a screwdriver in the slots, if necessary.

Now, try tightening or loosening one of the larger collimation thumbscrews with your fingers (Figure 14). Look into the focuser and see if the secondary mirror reflection has moved closer to the center of the primary. You can tell this easily with the collimation cap and mirror center mark by simply watching to see if the “dot” of the collimation cap is moving closer or further away from the “ring” on the center of the primary mirror mark. When you have the dot centered as much as is possible in the ring, your primary mirror is collimated. The view through the collimation cap should resemble Figure 10e. Re-tighten the locking thumbscrews.

A simple star test will tell you whether the optics are accurately collimated.

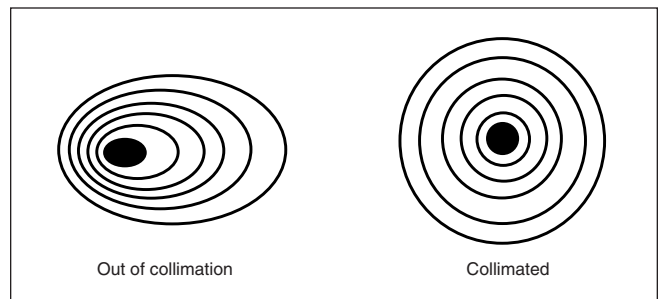
### Star-Testing the Telescope

When it is dark, point the telescope at a bright star and accurately center it in the eyepiece’s field of view. Slowly de-focus the image with the focusing knob. If the telescope is correctly collimated, the expanding disk should be a perfect circle (Figure 15). If the image is unsymmetrical, the scope is out of collimation. The dark shadow cast by the secondary mirror should appear in the very center of the out-of-focus circle, like the hole in a donut. If the “hole” appears off-center, the telescope is out of collimation.

If you try the star test and the bright star you have selected is not accurately centered in the eyepiece, the optics will always appear out of collimation, even though they may be perfectly aligned. It is critical to keep the star centered, so over time you will need to make slight corrections to the telescope’s position in order to account for the sky’s apparent motion.



**Figure 14:** The tilt of the primary mirror is adjusted by turning one or more of the three larger thumbscrews.



**Figure 15.** A star test will determine if a telescope’s optics are properly collimated. An unfocused view of a bright star through the eyepiece should appear as illustrated on the right if the optics are perfectly collimated. If the circle is unsymmetrical, as in the illustration on the left, the scope needs collimation.

## 6. Astronomical Observing

### Site Selection

Pick a location away from streetlights and bright yard lighting. Avoid viewing over rooftops and chimneys, as they often have warm air currents rising from them, which distort the image seen in the eyepiece. Similarly, you should not observe through an open (or closed!) window from indoors. Better yet, choose a site out-of-town, away from any “light pollution”. You’ll be stunned at how many more stars you’ll see! Most importantly, make sure that any chosen site has a clear view of a large portion of the sky.

### Cooling Your Telescope

As a general rule, telescopes should be allowed to “cool down” (or warm up) before they are used. If you bring optics from a warm air to cold air (or vice versa) without giving it time to reach “thermal equilibrium”, your telescope will give you distorted views. Allow your telescope 30 minutes to reach the temperature of the outdoors before using.

## Seeing and Transparency

Atmospheric conditions play a huge part in quality of viewing. In conditions of good “seeing”, star twinkling is minimal and objects appear steady in the eyepiece. Seeing is best overhead, worst at the horizon. Also, seeing generally gets better after midnight, when much of the heat absorbed by the Earth during the day has radiated off into space. Typically, seeing conditions will be better at sites that have an altitude over about 3000 feet. Altitude helps because it decreases the amount of distortion causing atmosphere you are looking through.

A good way to judge if the seeing is good or not is to look at bright stars about 40° above the horizon. If the stars appear to “twinkle”, the atmosphere is significantly distorting the incoming light, and views at high magnifications will not appear sharp. If the stars appear steady and do not twinkle, seeing conditions are probably good and higher magnifications will be possible. Also, seeing conditions are typically poor during the day. This is because the heat from the Sun warms the air and causes turbulence.

Good “transparency” is especially important for observing faint objects. It simply means the air is free of moisture, smoke, and dust. All tend to scatter light, which reduces an object’s brightness.

One good way to tell if conditions are good is by how many stars you can see with your naked eye. If you cannot see stars of magnitude 3.5 or dimmer then conditions are poor. Magnitude is a measure of how bright a star is, the brighter a star is, the lower its magnitude will be. A good star to remember for this is Megrez (mag. 3.4), which is the star in the “Big Dipper” connecting the handle to the “dipper”. If you cannot see Megrez, then you have fog, haze, clouds, smog, light pollution or other conditions that are hindering your viewing. (See Figure 16)

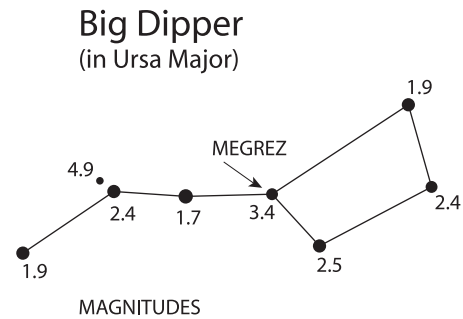
### Let Your Eyes Dark-Adapt

Do not expect to go from a lighted house into the darkness of the outdoors at night and immediately see faint nebulas, galaxies, and star clusters—or even very many stars, for that matter. Your eyes take about 30 minutes to reach perhaps 80% of their full dark-adapted sensitivity. Many observers notice improvements after several hours of total darkness. As your eyes become dark-adapted, more stars will glimmer into view and you will be able to see fainter details in objects you view in your telescope. So give yourself at least a little while to get used to the dark before you begin observing.

To see what you are doing in the darkness, use a red light flashlight rather than a white light. Red light does not spoil your eyes’ dark adaptation like white light does. A flashlight with a red LED light is ideal, or you can cover the front of a regular flashlight with red cellophane or paper. Beware, too, that nearby porch and streetlights and automobile headlights will spoil your night vision.

### Eyepiece Selection

By using eyepieces of varying focal lengths, it is possible to attain many magnifications with the AstroView 6 EQ. The tele-



**Figure 16.** Megrez connects the Big Dipper’s handle to its “pan”. It is a good guide to how conditions are. If you can not see Megrez (a 3.4 mag star) then conditions are poor.

scope comes with two high-quality Sirius Plössl eyepieces: a 25mm, which gives a magnification of 30x, and a 10mm, which gives a magnification of 75x. Other eyepieces can be used to achieve higher or lower powers. It is quite common for an observer to own five or more eyepieces to access a wide range of magnifications. This allows the observer to choose the best eyepiece to use depending on the object being viewed. At least to begin with, the two supplied eyepieces will suffice nicely.

Whatever you choose to view, always start by inserting your lowest-power (longest focal length) eyepiece to locate and center the object. Low magnification yields a wide field of view, which shows a larger area of sky in the eyepiece. This makes acquiring and centering an object much easier. If you try to find and center objects with high power (narrow field of view), it’s like trying to find a needle in a haystack!

Once you’ve centered the object in the eyepiece, you can switch to higher magnification (shorter focal length eyepiece), if you wish. This is especially recommended for small and bright objects, like planets and double stars. The Moon also takes higher magnifications well.

Deep-sky objects, however, typically look better at medium or low magnifications. This is because many of them are quite faint, yet have some extent (apparent width). Deep-sky objects will often disappear at higher magnifications, since greater magnification inherently yields dimmer images. This is not the case for all deep-sky objects, however. Many galaxies are quite small, yet are somewhat bright, so higher power may show more detail.

The best rule of thumb with eyepiece selection is to start with a low power, wide field, and then work your way up in magnification. If the object looks better, try an even higher magnification. If the object looks worse, then back off the magnification a little by using a lower-power eyepiece.

Now that you are all set up and ready to go, one critical decision must be made: what to look at?

### What to Expect

So what will you see with your telescope? You should be able to see bands on Jupiter, the rings of Saturn, craters on the moon, the waxing and waning of Venus, and possibly hun-

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dreds of deep sky objects. Do not expect to see as much color as you in NASA photos, since those are taken with long-exposure cameras and have “false color” added. Our eyes are not sensitive enough to see color in deep-sky objects except in a few of the brightest ones.

Remember that you are seeing these objects using your own telescope with your own eyes! The object you see in your eyepiece is in real-time, and not some conveniently provided image from an expensive space probe. Each session with your telescope will be a learning experience. Each time you work with your telescope it will get easier to use, and stellar objects will become easier to find. Take it from us, there is big difference between looking at a well-made full-color NASA image of a deep-sky object in a lit room during the daytime, and seeing that same object in your telescope at night. One can merely be a pretty image someone gave to you. The other is an experience you will never forget!

### **A. The Moon**

With its rocky and cratered surface, the moon is one of the most interesting and easy subjects for your scope. The best time to view it is during its partial phases when shadows fall on the craters and canyon walls to give its features definition. While the full moon may look like a tempting target, it is actually the worst time for viewing! The light of a full moon is too bright and lacks any decent surface definition.

Use an optional Moon filter to dim the Moon when it is very bright. It simply threads onto the bottom of the eyepiece from the focuser (you must first remove the eyepiece from the focuser to attach the filter). You’ll find the Moon filter improves viewing comfort, and helps bring out the subtle features in the lunar surface.

### **B. The Bright Planets**

The planets don’t stay put like stars do, so you will have to refer to charts published monthly on our website, telescope.com, or other astronomy references to locate them. Venus, Mars, Jupiter, and Saturn are the brightest objects in the sky after the Sun and the Moon. All four of these planets are not normally visible in the sky at one time, but chances are one or two of them will be.

**JUPITER** The largest planet, Jupiter, is a great subject to observe. You can see the disk of the giant planet and watch the ever-changing positions of its four largest moons, Io, Callisto, Europa, and Ganymede. If atmospheric conditions are good, you may be able to resolve thin cloud bands on the planet’s disk.

**SATURN** The ringed planet is a breathtaking sight when it is well positioned. The tilt angle of the rings varies over a period of many years; sometimes they are seen edge-on, while at other times they are broadside and look like giant “ears” on each side of Saturn’s disk. A steady atmosphere (good seeing) is necessary for a good view. You may see a tiny, bright “star” close by; that’s Saturn’s brightest moon, Titan.

**VENUS** At its brightest, Venus is the most luminous object in the sky, excluding the Sun and the Moon. It is so bright that sometimes it is visible to the naked eye during full daylight!

Ironically, Venus appears as a thin crescent, not a full disk, when at its peak brightness. Because it is so close to the Sun, it never wanders too far from the morning or evening horizon. No surface markings can be seen on Venus, which is always shrouded in dense clouds.

**MARS** If atmospheric conditions are good, you may be able to see some subtle surface detail on the Red Planet, possibly even the polar ice cap. Mars makes a close approach to Earth every two years; during those approaches its disk is larger and thus more favorable for viewing.

### **C. Stars**

Stars will appear like twinkling points of light in the telescope. Even the largest telescopes cannot magnify stars to appear as anything more than points of light! You can, however, enjoy the different colors of the stars and locate many pretty double and multiple stars. The famous “Double-Double” in the constellation Lyra and the gorgeous two-color double star Albireo in Cygnus are favorites. Defocusing the image of a star slightly can help bring out its color.

### **D. Deep-Sky Objects**

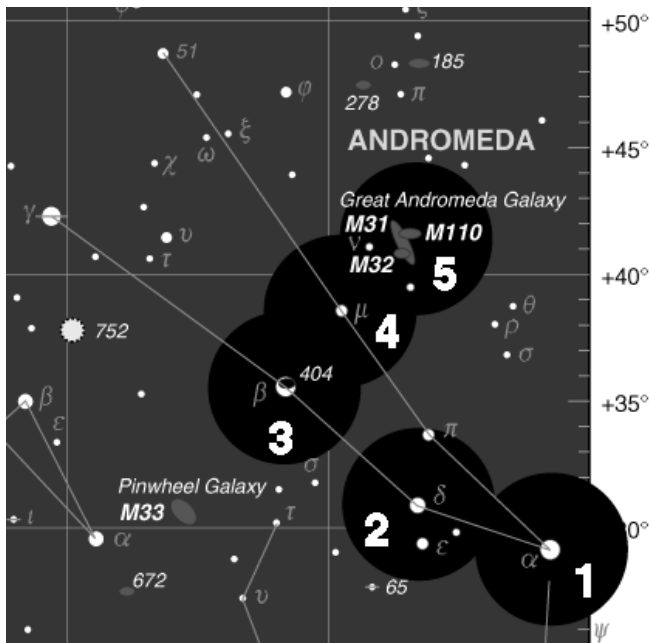
Under dark skies, you can observe a number of brighter deep-sky objects with your AstroView 6 EQ, including gaseous nebulae, open and globular star clusters, and the brighter galaxies. Most deep-sky objects are very faint, so it is important that you find an observing site well away from light pollution. Take plenty of time to let your eyes adjust to the darkness. As you become more experienced and your observing skills improve, you will be able to coax out more and more intricate details.

### **Finding Deep-Sky Objects: Starhopping**

Starhopping, as it is called by astronomers, is perhaps the simplest way to hunt down objects to view in the night sky. It entails first pointing the telescope at a star close to the object you wish to observe, and then progressing to other stars closer and closer to the object until it is in the field of view of the eyepiece. It is a very intuitive technique that has been employed for hundreds of years by professional and amateur astronomers alike. Keep in mind, as with any new task, that starhopping may seem challenging at first, but will become easier over time and with practice.

To starhop, only a minimal amount of additional equipment is necessary. A star chart or atlas that shows stars to at least magnitude 5 is required. Select one that shows the positions of many deep-sky objects, so you will have lots of options to choose from. If you do not know the positions of the constellations in the night sky, you will need to get a planisphere to identify them.

Start by choosing bright objects to view. The brightness of an object is measured by its visual magnitude; the brighter an object, the lower its magnitude. Choose an object with a visual magnitude of 9 or lower. Many beginners start with the Messier objects, which represent some of the best and brightest deep-sky objects.



**Figure 17.** Starhopping is a good way to locate hard-to-find objects. Refer to a star chart to map a route to the object that uses bright stars as guideposts. Center the first star you've chosen in the finder scope and telescope eyepiece (1). Now move the scope carefully in the direction of the next bright star (2), until it is centered. Repeat (3 and 4). The last hop (5) should place the desired object in the eyepiece.

Determine in which constellation the object lies. Now, find the constellation in the sky. If you do not recognize the constellations on sight, consult a planisphere. The planisphere gives an all-sky view and shows which constellations are visible on a given night at a given time.

Now, look at your star chart and find the brightest star in the constellation that is near the object you are trying to find. Using the finder scope, point the telescope at this star and center it in the crosshairs. Next, look again at the star chart and find another suitably bright star near the bright star currently centered in the finder. Keep in mind that the field of view of the finder scope is 7°, so you should choose another star that is no more than 7° from the first star, if possible. Move the telescope slightly, until it is centered on the new star.

Continue using the stars as guideposts until you are at the approximate position of the object you are trying to find (Figure 17). Look in the telescope's eyepiece, and the object should be somewhere in the field of view. If it's not, sweep the telescope carefully around the immediate vicinity until the object is found.

If you have trouble finding the object, start the starhop again from the brightest star near the object you wish to view. This time, be sure the stars indicated on the star chart are in fact the stars you are centering in the eyepiece.

## E. The Sun

You can change your nighttime scope into a daytime Sun viewer by installing an optional full-aperture solar-filter over the front opening of a AstroView 6 EQ. The primary attraction is sunspots, which change in shape, appearance, and location daily. Sunspots are directly related to magnetic activity in the sun and follow an 11 year cycle. Many observers like to make drawings of sunspots to monitor how the sun is changing from day to day.

**Important Note:** Do NOT look at the Sun with any optical instrument without a professionally made solar filter, or permanent eye damage could result. Also remember to cover or remove the finder scope before attempting to view the sun.

## 7. Astrophotography

Several different types of astrophotography can be successfully attempted with the AstroView 6 EQ.

### Moon Photography

This is perhaps the simplest form of astrophotography, as no motor drive is required. All that is needed is a T-Ring for your specific camera model. Attach the T-ring to your camera body, and then thread the T-Ring on to the focuser drawtube.

Now you are ready to shoot. Point the telescope toward the Moon, and center it within the camera's viewfinder. Focus the image with the telescope's focuser. Try several exposure times, all less than 1 second, depending on the phase of the moon and the ISO (film speed) of the film being used. A remote shutter release is recommended, as touching the camera's shutter release can vibrate the camera enough to ruin the exposure.

### Planetary Photography

Once basic Moon photography has been mastered, it's time to get images of the planets. This type of astrophotography also works to get highly magnified shots of the Moon. In addition to the T-ring, you will need a Universal 1.25" Camera Adapter. The EQ-3 Motor Drive System (single or dual axis) is also required. This is because a longer exposure is necessary, which would cause the image to blur if no motor drive was used for tracking. The equatorial mount must be accurately polar aligned, too.

As before, connect the T-ring to your camera. Before connecting the Universal camera adapter to the T-Ring, an eyepiece must be inserted and locked into the body of the Universal camera adapter. Start by using a medium-low power eyepiece (about 25mm); you can increase the magnification later with a high-power eyepiece. Then connect the entire camera adapter, with eyepiece inside, to the T-Ring. Insert the whole system into the telescope's focuser drawtube and secure firmly with the thumbscrews.

Aim the telescope at the planet (or Moon) you wish to shoot. The image will be highly magnified, so you may need to use the finder scope to center it within the camera's viewfinder.



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Turn the motor drive on. Adjust the telescope's focuser so that the image appears sharp in the camera's viewfinder. The camera's shutter is now ready to be opened. A remote shutter release must be used or the image will be blurred beyond recognition. Try exposure times between 1 and 10 seconds, depending upon the brightness of the planet to be photographed and the ISO of the film being used.

### **“Piggybacking Photography”**

The Moon and planets are interesting targets for the budding astrophotographer, but what next? Literally thousands of deep-sky objects can be captured on film with a type of astrophotography called “piggybacking”. The basic idea is that the camera with its own camera lens attached rides on top of the main telescope. The telescope and camera both move with the rotation of the Earth when the mount is polar aligned and the motor drive is engaged. This allows for a long exposure through the camera without having the object or background stars blurred. In addition to the motor drive (dual-axis), and illuminated reticle eyepiece is also needed. The T-ring and camera adapter are not needed, since the camera is exposing through its own lens. Any camera lens with a focal length between 35mm and 400mm is appropriate.

On the top of one of the tube rings is a piggyback camera adapter. This is the black knob with the threaded shaft protruding through it. The tube ring with the piggyback adapter should be closest to the open end of the telescope tube. Remove the tube rings from the equatorial mount and swap their position if necessary. Now, connect the camera to the piggyback adapter. There should be a 1/4"-20 mounting hole in the bottom of the camera's body. Thread the protruding shaft of the piggyback adapter into the 1/4"-20 mounting hole in the camera a few turns. Position the camera so it is parallel with the telescope tube and turn the knurled black knob of the piggyback adapter counter-clockwise until the camera is locked into position.

Aim the telescope at a deep-sky object. It should be a fairly large deep-sky object, as the camera lens will likely have a wide field of view. Check to make sure that the object is also centered in the camera's viewfinder. Turn the motor drive on. Now, look into the telescope's eyepiece and center the brightest star within the field of view. Remove the eyepiece and insert the illuminated reticle eyepiece into the focuser drawtube. Turn the eyepiece's illuminator on (dimly!). Recenter the bright star (guide star) on the crosshairs of the reticle eyepiece. Check again to make sure that the object to be photographed is still centered within the camera's field of view. If it is not, recenter it by repositioning the camera on the piggyback adapter, or by moving the main telescope. If you move the main telescope, then you will need to recenter another guide star on the illuminated eyepiece's crosshairs. Once the object is centered in the camera and a guide star is centered in the reticle eyepiece, you're ready to shoot.

Deep sky objects are quite faint, and typically require exposures on the order of 10 minutes. To hold the camera's shutter open this long, you will need a locking shutter release cable. Set the camera's shutter to the “B” (bulb) setting. Depress the

locking shutter release cable and lock it. You are now exposing your first deep-sky object.

While exposing through the camera lens, you will need to monitor the accuracy of the mount's tracking by looking through the illuminated reticle eyepiece in the main telescope. If the guide star drifts from its initial position, then use the hand controller of the motor drive to “move” the guide star back to the center of the crosshairs. Any drifting along the Dec. axis is a result of improper polar alignment, so if the guide star drifts greatly in Dec., the mount may need to be polar aligned more accurately.

When the exposure is complete, unlock the shutter release cable and close the camera's shutter.

Astrophotography can be enjoyable and rewarding, as well as frustrating and time-consuming. Start slowly and consult outside resources, such as books and magazines, for more details about astrophotography. Remember ... have fun!

## **8. Care and Maintenance**

If you give your telescope reasonable care, it will last a lifetime. Store it in a clean, dry, dust-free place, safe from rapid changes in temperature and humidity. Do not store the telescope outdoors, although storage in a garage or shed is OK. Small components like eyepieces and other accessories should be kept in a protective box or storage case. Keep the dust cover on the front of the telescope when not in use.

Your AstroView 6 EQ requires very little mechanical maintenance. The optical tube is steel and has a smooth painted finish that is fairly scratch-resistant. If a scratch does appear on the tube, it will not harm the telescope. If you wish, you may apply some auto touch-up paint to the scratch. Smudges on the tube can be wiped off with a soft cloth and a household cleaner such as Windex or Formula 409.

### **Cleaning Lenses**

Any quality optical lens cleaning tissue and optical lens cleaning fluid specifically designed for multi-coated optics can be used to clean the exposed lenses of your eyepieces or finder scope. Never use regular glass cleaner or cleaning fluid designed for eyeglasses. Before cleaning with fluid and tissue, however, blow any loose particles off the lens with a blower bulb or compressed air. Then apply some cleaning fluid to a tissue, never directly on the optics. Wipe the lens gently in a circular motion, then remove any excess fluid with a fresh lens tissue. Oily fingerprints and smudges may be removed using this method. Use caution; rubbing too hard may scratch the lens. On larger lenses, clean only a small area at a time, using a fresh lens tissue on each area. Never reuse tissues.

### **Cleaning Mirrors**

You should not have to clean the telescope's mirrors very often; normally once every year or so. Covering the telescope with the dust cover when it is not in use will prevent dust from accumulating on the mirrors. Improper cleaning can scratch mirror coatings, so the fewer times you have to clean the mir-

rors, the better. Small specks of dust or flecks of paint have virtually no effect on the visual performance of the telescope.

The large primary mirror and the elliptical secondary mirror of your telescope are front-surface aluminized and over-coated with hard silicon dioxide, which prevents the aluminum from oxidizing. These coatings normally last through many years of use before requiring re-coating (which is easily done).

To clean the secondary mirror, first remove it from the telescope. Do this by holding the secondary mirror holder stationary while turning the center Phillips-head screw. Be careful, there is a spring between the secondary mirror holder and the phillips head screw. Be sure that it will not fall into the optical tube and hit the primary mirror. Handle the mirror by its holder; do not touch the mirror surface. Then follow the same procedure described below for cleaning the primary mirror.

To clean the primary mirror, carefully remove the mirror cell from the telescope. For the AstroView 6 EQ, this means you must loosen the four screws on the side of the tube near the primary mirror. You do not need to remove the collimation screws on the bottom of the mirror cell. Remove the mirror cell from the tube. You will notice the primary mirror is held down with three clips held by two screws each. Loosen the screws and remove the clips.

You may now remove the mirror from the mirror cell. Do not touch the surface of the mirror with your fingers. Lift the mirror carefully by the edges. Set the mirror in a clean soft towel. Fill a clean sink, free of abrasive cleanser, with room-temperature water, a few drops of liquid dishwashing detergent, and, if possible, a capfull of rubbing alcohol. Submerge the mirror (aluminized face up) in the water and let it soak for a

few minutes (or hours if it's a very dirty mirror). Wipe the mirror under water with clean cotton balls, using extremely light pressure and stroking in straight line across the mirror. Use one ball for each wipe across the mirror. Then rinse the mirror under a stream of lukewarm water. Any particles on the surface can be swabbed gently with a series of cotton balls, each used just one time. Dry the mirror in a stream of air (a "blower bulb" works great), or remove any stray drops of water with the corner of a paper towel. Water will run off a clean surface. Cover the mirror surface with Kleenex, and leave the mirror in a warm area until it is completely dry before replacing in the mirror cell and telescope.

## 9. Specifications

Primary mirror diameter: 150mm (5.9")

Primary mirror coating: Aluminized, SiO<sub>2</sub> overcoat

Focal Length: 750mm

Focal Ratio: f/5

Eyepieces: 25mm and 10mm Sirius Plössls, fully coated with two lens surfaces multi-coated, 1.25" diameter barrel

Magnification: 30x (with 25mm) and 75x (with 10mm)

Finder Scope: 6x30 achromatic, 7° field of view

Focuser: Rack-and-pinion, accepts 1.25" eyepieces

Mount: German-type equatorial, EQ-3

Tripod: Aluminum

Motor Drives: Optional

## One-Year Limited Warranty

This Orion AstroView 6 EQ is warranted against defects in materials or workmanship for a period of one year from the date of purchase. This warranty is for the benefit of the original retail purchaser only. During this warranty period Orion Telescopes & Binoculars will repair or replace, at Orion's option, any warranted instrument that proves to be defective, provided it is returned postage paid to: Orion Warranty Repair, 89 Hangar Way, Watsonville, CA 95076. If the product is not registered, proof of purchase (such as a copy of the original invoice) is required.

This warranty does not apply if, in Orion's judgment, the instrument has been abused, mishandled, or modified, nor does it apply to normal wear and tear. This warranty gives you specific legal rights, and you may also have other rights, which vary from state to state. For further warranty service information, contact: Customer Service Department, Orion Telescopes & Binoculars, 89 Hangar Way, Watsonville, CA 95076; (800)-676-1343.

## Orion Telescopes & Binoculars

89 Hangar Way, Watsonville, CA 95076

Customer Support Help Line (800)-676-1343 • Day or Evening