

INSTRUCTION MANUAL

Orion AstroView™ 120ST EQ

#9005 Equatorial Refracting Telescope



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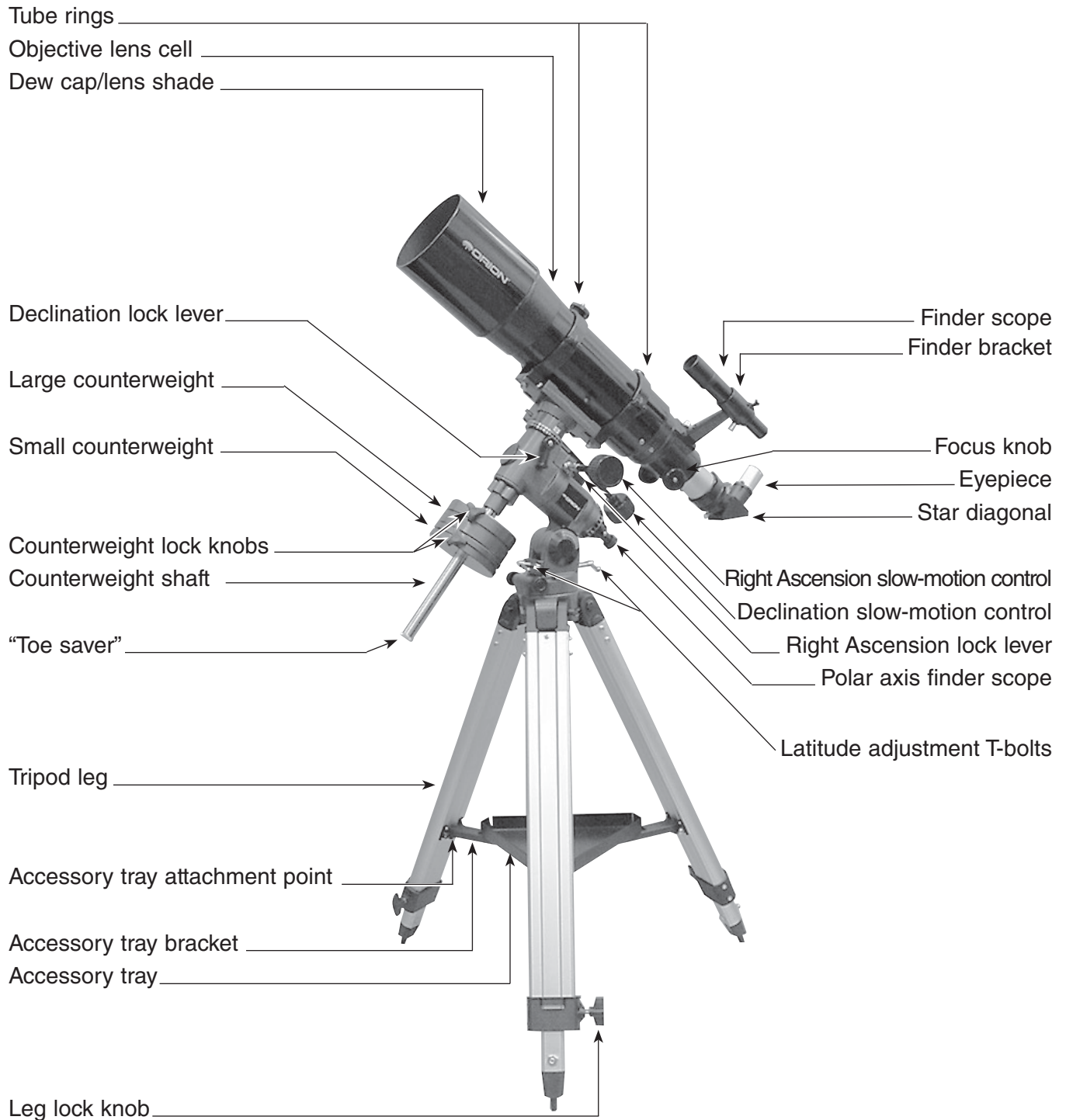


Figure 1. The AstroView 120ST EQ Refractor

Congratulations on your purchase of a quality Orion telescope! Your new AstroView 120ST EQ Refractor 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.

If you have never owned a telescope, we are pleased to welcome you to amateur astronomy. Take some time to familiarize yourself with the night sky. Learn to recognize the patterns of stars in the major constellations; a star wheel, or planisphere, available from Orion or from your local telescope shop, will greatly help. With a little practice, a little patience, and a reasonably dark sky away from city lights, you'll find your telescope to be a never-ending source of wonder, exploration, and relaxation.

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

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1. Parts List

Qty.	Description	
1	Optical tube assembly	1 Finder scope bracket with O-ring
1	German-type equatorial mount	1 Mirror star diagonal (1.25")
1	Large counterweight	1 25mm (40x) Plössl eyepiece (1.25")
1	Small counterweight	1 10mm (100x) Plössl eyepiece (1.25")
1	Counterweight shaft	1 Dust cap
3	Tripod Legs with mounting hardware	4 Assembly Tools (2 wrenches, Phillips screwdriver, flat-head screwdriver key)
1	Accessory tray with mounting hardware	
1	Accessory tray bracket	
2	Slow-motion control cables	
1	Polar axis finder scope	
1	Plastic cover for polar axis finder scope	
2	Optical tube mounting rings	
1	6x30 achromatic crosshair finder scope	

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.*

2. Assembly

Carefully open all of the boxes in the shipping container. Make sure all the parts listed in Section 1 are present. Save the boxes and packaging material. In the unlikely event that you need to return the telescope, 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 objective lens or 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. **NEVER** remove any lens assembly from its housing for any reason, or the product warranty and return policy will be voided.

1. Lay the equatorial mount on its side. Attach the tripod legs one at a time to the mount using the bolts installed in the tops of the tripod legs. Remove the bolt from the leg, line up the holes in the top of the leg with the holes in the base of the mount, and reinstall the bolt so it passes through the leg and the mount. Tighten the wingnuts only finger-tight, for now. Note that the accessory tray bracket attachment point on each leg should face inward.
2. Tighten the leg lock knobs at 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 enough to connect each end of the accessory tray bracket to the attachment point on each leg. Use the screw that comes installed in each attachment point to do this. First remove the screw using the supplied screwdriver, then line up one of the ends of the bracket with the attachment point and reinstall the screw. Make sure the smooth side of the accessory tray bracket faces up.
4. Now, with the accessory tray bracket attached, spread the tripod legs apart as far as they will go, until the bracket is taut. Attach the accessory tray to the brackets 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.
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 (located directly above the Orion logo on one side of the mount) is pointing to the line at “40.” To do this, loosen one of the latitude adjusting T-bolts and then tighten the other latitude adjusting T-bolt until the

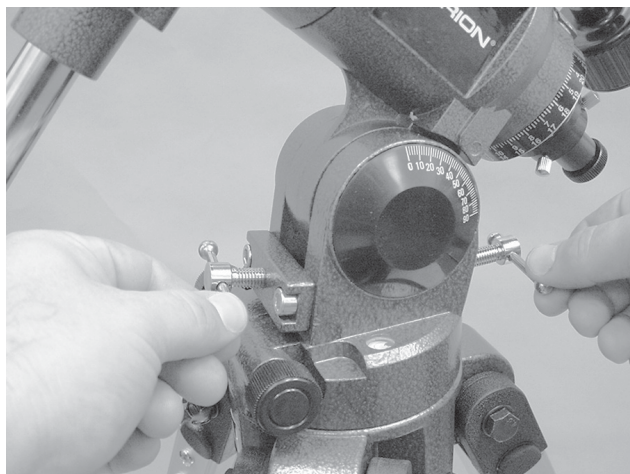


Figure 2: To adjust the latitude angle of the equatorial mount, loosen one of the two latitude adjustment T-bolts, then tighten the other.

- pointer and the “40” line up (**Figure 2**). 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. It 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 bolts that come installed in the rings. Remove the bolts, then push them, with the washers still attached, up through the holes in the tube ring mounting plate (on the top of the equatorial mount) and rethread them into the bottom of the tube rings. Tighten the bolts 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 so the focus knobs are on the underside of the telescope. 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 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.
12. To place the finder scope in the finder scope bracket (**Figure 3**), first unthread the two black nylon thumbscrews 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 groove 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 alignment thumbscrews while pulling the chrome, spring-loaded tensioner on the bracket with your fingers. 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 thumbscrews a couple of turns each to secure the finder scope in place.
13. Insert the base of the finder scope bracket into the dovetail slot on the top of the focuser. Lock the bracket into position by tightening the knurled thumbscrew on the dovetail slot.
14. Remove the cover cap on the end of the focuser. Insert the chrome barrel of the star diagonal into the focuser and secure with the thumbscrew on the drawtube.
15. Then insert an eyepiece into the star diagonal and secure it in place with the thumbscrews on the diagonal. (Always loosen the thumbscrews before rotating or removing the diagonal or an eyepiece.)
16. Install the polar axis finder scope into its housing inside the R.A. axis of the equatorial mount (**Figure 4**). First loosen the three thumbscrews on the housing, which is located at the rear of the R.A. axis. 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 reseal 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.
17. Remove the objective lens dust cover.

The AstroView 120ST is now assembled and should appear as pictured in **Figure 1**.

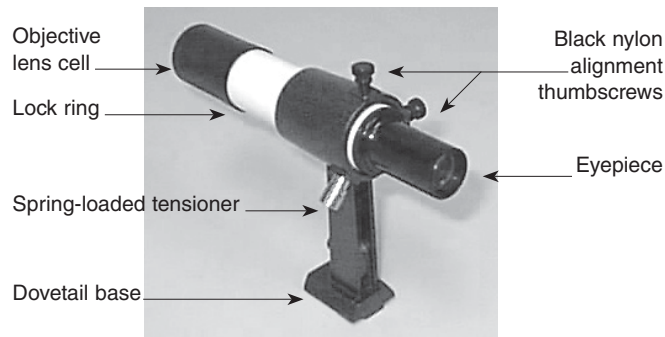


Figure 3. The 6x30 finder scope and bracket.

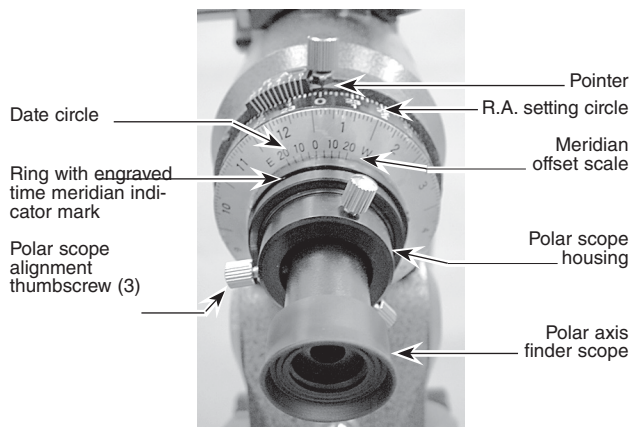


Figure 4. The polar axis finder scope installed in the right ascension (R.A.) axis of the mount.

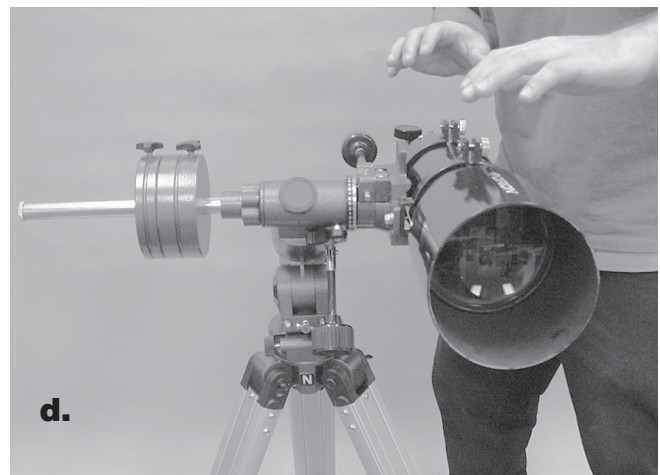
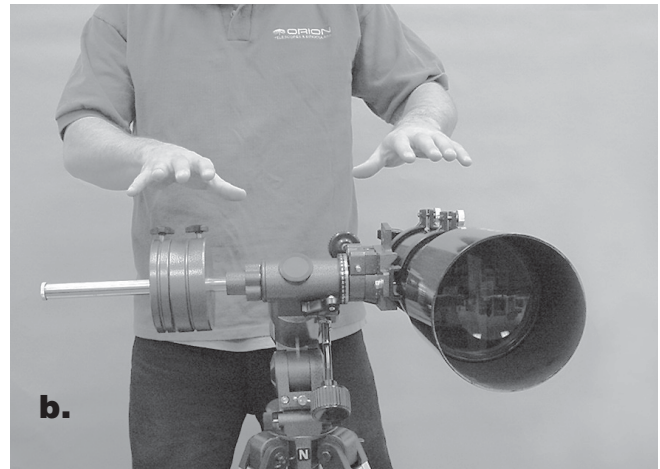


Figure 5. Proper operation of the equatorial mount requires that the telescope tube be balanced on both the R.A. and Dec. axes. (a) With the R.A. lock knob released, slide the counterweight along the counterweight shaft until it just counterbalances the tube. (b) When you let go with both hands, the tube should not drift up or down. (c) With the Dec. lock knob released, loosen the tube ring lock 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.

3. 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 the counterweight lock knobs and slide the weights along the shaft until they exactly counterbalance the telescope (**Figure 5a**) That's the point at which the shaft remains horizontal even when you let go with both hands (**5b**).
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. 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) (**5c**).
6. Position the telescope in the mounting rings so it remains horizontal when you carefully let go with both hands. This is the balance point for the optical tube with respect to the Dec. axis (**5d**).
7. 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.

4. Aligning the Finder Scope

A finder scope has a wide field of view to facilitate the location of objects for subsequent viewing through the main telescope, which has a much narrower field of view. The finder scope and the main telescope must be aligned so they point to exactly the same spot in the sky.

Alignment is easiest to do in daylight hours. First, insert the lowest-power (25mm) eyepiece into the star diagonal. Then loosen the R.A. and Dec. lock levers so the telescope can be moved freely.

Point the main telescope at a discrete object such as the top of a telephone pole or a street sign that is at least a quarter-mile away. Move the telescope so the target object appears in the very center of the field of view when you look into the eyepiece. Now tighten the R.A. and Dec. lock levers. Use the slow-motion control knobs to re-center the object in the field of view, if it moved off center when you tightened the lock levers.

Now look through the finder scope. Is the object centered in the finder scope's field of view, i.e., on the crosshairs? If not, hopefully it will be visible somewhere in the field of view, so that only fine adjustment of the finder scope alignment screws will be needed to center it on the crosshairs. Otherwise you'll have to make coarser adjustments to the two black nylon alignment thumbscrews to redirect the aim of the finder scope.

Note that the image seen through the finder scope appears upside down. This is normal for astronomical finder scopes.

Once the target object is centered on the crosshairs of the finder scope, look again in the main telescope's eyepiece and see if it is still centered there as well. If it isn't, repeat the entire process, making sure not to move the main telescope while adjusting the alignment of the finder scope.

When the target object is centered on the crosshairs of the finder scope and in the telescope's eyepiece, the finder scope is now aligned and ready to be used for an observing session. The finder scope and bracket can be removed from the dovetail for storage, and then reinstalled without significantly changing the finder scope's alignment.

The finder scope alignment should 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 the telescope eyepiece, and then adjust the finder scope's alignment screws until the star or planet is also centered on the finder's crosshairs. The finder scope is an invaluable tool for finding objects in the night sky; its usage for this purpose will be discussed later, in detail.

If, when looking through the finder scope, you notice that the images appear somewhat out of focus, you will need to refocus the finder scope for your eyes. First loosen the lock ring located behind the objective lens cell on the body of the finder scope (see **Figure 3**). Back the lock ring off by a few turns, for now. Refocus the finder scope on a distant object by thread-

ing the objective lens cell in or out of the finder scope body. Precise focusing will be achieved by focusing the finder scope on a bright star. Once the image appears sharp, retighten the lock ring behind the objective lens cell. The finder scope's focus should not need to be adjusted again.

5. 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 6**) 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 7**). The two stars at the end of the "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

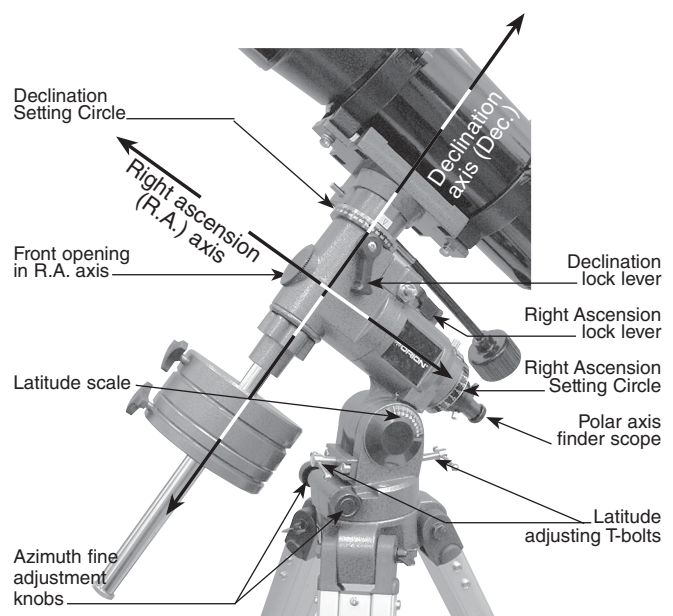


Figure 6. The equatorial mount of the AstroView 120ST EQ.

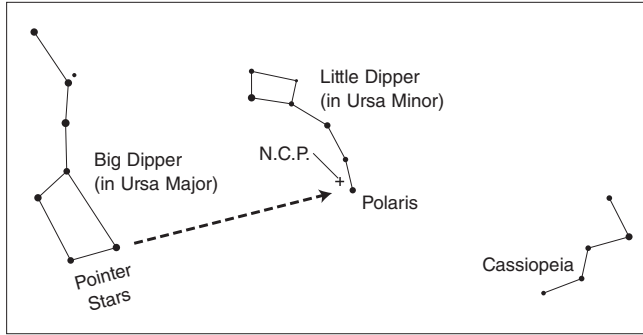


Figure 7. To find Polaris in the night sky, look north and find the Big Dipper. Extend an imaginary line from the two "Pointer Stars" in the bowl of the Big Dipper. Go about five times the distance between those stars and you'll reach Polaris, which lies within 1° of the north celestial pole (NCP).

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 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 8**). 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.

Note: 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 nice feature of the AstroView 120ST is the polar axis finder scope housed inside the R.A. axis of the equatorial mount (see **Figure 4**). 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 round cover cap from the front opening in the R.A. axis of the mount (see **Figure 6**). Look through the polar finder at a distant object during the day. 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 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 4**.

1. Loosen the large thumbscrew just above the R.A. setting circle. 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 3**). Retighten the thumbscrew.
2. Rotate the date circle until the "0" line on the meridian offset scale lines up with the time meridian indicator

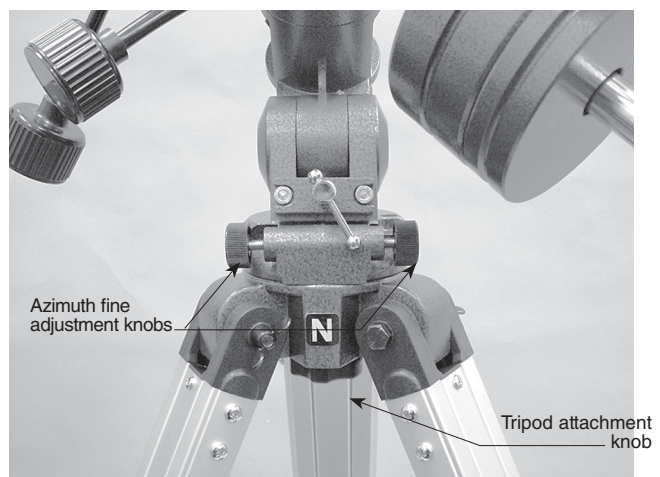


Figure 8. For polar alignment, position the tripod so that the "N" label at the base of the mount faces north. The two azimuth fine adjustment knobs above it are used to make small adjustments to the mount's azimuth position.

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.
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, we 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 on 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, you must 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, then 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, then 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°, then 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, you would rotate the telescope in R.A. until the line above the “21” on the R.A. setting circle lines up with the long line between the “10” and “11” on the date circle.

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. Do this by rotating the tripod left or right, and adjusting the tilt of the R.A. axis up-or-down with the latitude adjustment T-bolts. When you are close, you can use the azimuth fine adjustment knobs (**Figure 8**) 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.

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 astro-photography 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.

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 astronomical 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.

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 (the negative sign denotes south of the celestial equator). There are 60 minutes in 1 hour of R.A. and there are 60 arc-minutes in 1 degree of declination.

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. The Dec. setting circle is scaled in degrees.

Before you can use the setting circles to locate objects, the mount must be accurately polar aligned, and the setting circles must be calibrated. The declination setting circle was calibrated at the factory, and should read 90° when the telescope optical tube is pointing exactly along the R.A. axis.

Calibrating the Right Ascension Setting Circle

1. Identify a bright star near the celestial equator 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. Center the star in the telescope's eyepiece. Lock the R.A. and Dec. lock levers.
4. Loosen the large thumbscrew just above the R.A. setting circle and rotate the R.A. setting circle so the pointer indicates the R.A. coordinate listed for the bright star in the star atlas. 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. If the telescope is being aimed toward the south and the Dec. setting circle pointer passes the 0° indicator, the value on the Dec. setting circle becomes a negative number. 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. Retighten the lock lever.

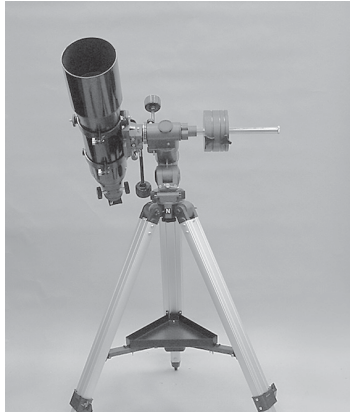
Most setting circles are not accurate enough to put an object dead-center in your finder scope's field of view, but they'll get you close, assuming the equatorial mount is accurately polar-aligned. The R.A. setting circle should be recalibrated every time you wish to locate a new object. Do so by calibrating the setting circle for the centered object before moving on to the next one.

Confused About Pointing the Telescope?

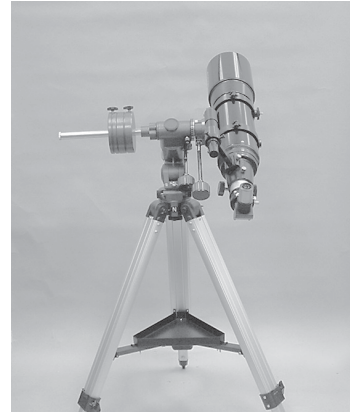
Beginners occasionally experience some confusion about how to point the telescope overhead or in other directions. In **Figure 1** the telescope is pointed north as it would be during polar alignment. The counterweight shaft is oriented downward. But it will not look like that when the telescope is pointed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

One thing you DO NOT do is 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 telescope 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.



a.



b.



c.



d.

Figure 9. This illustration shows the telescope pointed in the four cardinal directions: **(a)** north, **(b)** south, **(c)** east, **(d)** west. Note that the tripod and mount have not been moved; only the telescope tube has been moved on the R.A. and Dec. axes.

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!

6. Using Your Telescope— Astronomical Observing

Choosing an Observing Site

When selecting a location for observing, get as far away as possible from direct artificial light such as streetlights, porch

lights, and automobile headlights. The glare from these lights will greatly impair your dark-adapted night vision. Set up on a grass or dirt surface, not asphalt, because asphalt radiates more heat. Heat disturbs the surrounding air and degrades the images seen through the telescope. Avoid viewing over rooftops and chimneys, as they often have warm air currents rising from them. Similarly, avoid observing from indoors through an open (or closed) window, because the temperature difference between the indoor and outdoor air will cause image blurring and distortion.

If at all possible, escape the light-polluted city sky and head for darker country skies. You'll be amazed at how many more stars and deep-sky objects are visible in a dark sky!

Cooling the Telescope

All optical instruments need time to reach “thermal equilibrium.” The bigger the instrument and the larger the temperature change, the more time is needed. Allow at least a half-hour for your telescope to cool to the temperature outdoors. In very cold climates (below freezing), it is essential to store the telescope as cold as possible. If it has to adjust to more than a 40° temperature change, allow at least one hour.

Aiming the Telescope

To view an object in the main telescope, first loosen both the R.A. and Dec. lock levers. Aim the telescope at the object you wish to observe by “eyeballing” along the length of the telescope tube (or use the setting circles to “dial in” the object’s coordinates). Then look through the (aligned) finder scope and move the telescope tube until the object is generally centered on the finder’s crosshairs. Retighten the R.A. and Dec. lock levers. Then accurately center the object on the finder’s crosshairs using the R.A. and Dec. slow-motion controls. The object should now be visible in the main telescope with a low-power (long focal length) eyepiece. If necessary, use the R.A. and Dec. slow-motion controls to re-position the object within the field-of-view of the main telescope’s eyepiece.

Focusing the Telescope

Practice focusing the telescope in the daytime before using it for the first time at night. Start by turning the focus knob until the focuser drawtube is near the center of its adjustment range. Insert the star diagonal into the drawtube and an eyepiece into the star diagonal (secure with the thumbscrews). Point the telescope at a distant subject and center it in the field of view. Now, slowly rotate the focus knob until the object comes into sharp focus. Go a little bit beyond sharp focus until the image just starts to blur again, then reverse the rotation of the knob, just to make sure you hit the exact focus point. The telescope can only focus on objects at least 50 to 100 feet away.

Do You Wear Eyeglasses?

If you wear eyeglasses, you may be able to keep them on while you observe, if your eyepieces have 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 refocusing the telescope the needed amount.

Calculating the Magnification

It is desirable to have a range of eyepieces of different focal lengths, to allow viewing over a range of magnifications. To calculate the magnification, or power, of a telescope, simply divide the focal length of the telescope by the focal length of the eyepiece (the number printed on the eyepiece):

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

For example, the AstroView 120ST, which has a focal length of 600mm, used in combination with a 25mm eyepiece, yields a power of

$$600 \div 25 = 24x.$$

Every telescope has a useful limit of power of about 45x-60x per inch of aperture. Claims of higher power by some telescope manufacturers are a misleading advertising gimmick and should be dismissed. Keep in mind that at higher powers, an image will always be dimmer and less sharp (this is a fundamental law of optics). The steadiness of the air (the “seeing”) will limit how much magnification an image can tolerate.

Always start viewing with your lowest-power (longest focal length) eyepiece in the telescope. After you have located and looked at the object with it, you can try switching to a higher power eyepiece

to ferret out more detail, if atmospheric conditions permit. If the image you see is not crisp and steady, reduce the magnification by switching to a longer focal length eyepiece. As a general rule, a small but well-resolved image will show more detail and provide a more enjoyable view than a dim and fuzzy, over-magnified image.

Use of 2" Eyepieces

Another nice feature of the AstroView 120ST is its ability to use either 1.25" or 2" barrel-diameter eyepieces. At low powers (long focal lengths), 2" eyepieces can give a wider field of view than standard 1.25" eyepieces. This is especially desirable for observing deep-sky objects, as many of them appear quite big, but faint. If you want to use 2" eyepieces, such as the Orion Optiluxe 2" eyepieces, we recommend that you also purchase a 2" star diagonal for refractors; this will provide for a comfortable viewing angle.

To use 2" eyepieces, simply loosen the two large thumbscrews on the focuser drawtube that are just in front of the thumbscrew that holds the provided 1.25" star diagonal in place. Once these large thumbscrews are loosened, the entire back end of the focuser, including any 1.25" diagonal and eyepiece that may be attached, comes off, exposing the 2" diameter focuser drawtube. Now, insert your 2" star diagonal into the drawtube and secure with the two large thumbscrews. Insert a 2" eyepiece into the 2" diagonal, secure it in place with the thumbscrew on the diagonal, and you’re ready to observe.

Let Your Eyes Dark-Adapt

Don’t 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. As your eyes become dark-adapted, more stars will glimmer into view and you’ll be able to see fainter details in objects you view in your telescope.

To see what you’re doing in the darkness, use a red-filtered 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, such as the Orion RedBeam LED flashlight, or you can cover the front of a regular incandescent flashlight with red cellophane or paper. Beware, too, that nearby porch and street lights and car headlights will ruin your night vision.

“Seeing” and Transparency

Atmospheric conditions vary significantly from night to night. “Seeing” refers to the steadiness of the Earth’s atmosphere at a given time. In conditions of poor seeing, atmospheric turbulence causes objects viewed through the telescope to “boil.” If the stars are twinkling noticeably when you look up at the sky with just your eyes, the seeing is bad and you will be limited to viewing with low powers (bad seeing affects images at high powers more severely). Planetary observing may also be poor.

In conditions of good seeing, star twinkling is minimal and images 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.

Avoid looking over buildings, pavement, or any other source of heat, as they will cause “heat wave” disturbances that will distort the image you see through the telescope.

Especially important for observing faint objects is good “transparency”—air free of moisture, smoke, and dust. All tend to scatter light, which reduces an object’s brightness. Transparency is judged by the magnitude of the faintest stars you can see with the unaided eye (6th magnitude or fainter is desirable).

Note About Chromatic Abberation

Chromatic abberation literally means color distortion. Whenever light passes through one material to another, light of different wavelengths (color), is bent by different amounts. This is a problem that plagues refractor-type telescopes, since light passes through both air and glass to form an image. Most astronomical objects emit a spectrum comprised of many different wavelengths of light, so each wavelength will be bent by a slightly different amount when passing through a lens. This results in each color of light reaching precise focus at a slightly different point, which will provide unacceptable images.

Achromatic refractors, like the AstroView 120ST, are designed to minimize chromatic abberation to acceptable levels. The objective lens is actually comprised of two individual lenses, called elements, made of different materials, which bend light in slightly different ways. By precisely spacing and shaping the elements, the chromatic abberation incurred when light passes through air and the first glass element is reduced by the way the second element bends the light. The result is an image that is much better color corrected than a non-achromatic (one element) objective lens.

Even with the achromatic lens design, however, the AstroView 120ST will suffer a bit from chromatic abberation due to its large aperture and short focal length. This will be noticeable, to some degree, on extremely bright objects, such as the brightest stars in the sky. What you will notice is that the object, when focused, has a slight “purple-halo” around it. This will not present a problem for most observers, as the eye readily adapts to the view and is still able to distinguish fine details. Chromatic abberation will never inhibit deep sky observing, as deep sky objects are too faint to cause any noticeable color distortion.

How to Find Interesting Celestial Objects

To locate celestial objects with your telescope, you first need to become reasonably familiar with the night sky. Unless you know how to recognize the constellation Orion, for instance, you won’t have much luck locating the Orion Nebula, unless, of course, you look up its celestial coordinates and use the telescope’s setting circles. Even then, it would be good to know in advance whether that constellation will be above the horizon at the time you plan to observe. A simple planisphere, or star wheel, can be a valuable tool both for learning the constellations and for determining which ones are visible on a given night at a given time.

A good star chart or atlas will come in very handy for helping find objects among the dizzying multitude of stars overhead. Except for the Moon and the brighter planets, it’s pretty time-consuming and frustrating to hunt for objects randomly, with-

out knowing where to look. You should have specific targets in mind before you begin observing.

Start with a basic star atlas, one that shows stars no fainter than 5th or 6th magnitude. In addition to stars, the atlas will show the positions of a number of interesting deep-sky objects, with different symbols representing the different types of objects, such as galaxies, open star clusters, globular clusters, diffuse nebulas, and planetary nebulas. So, for example, your atlas might show a globular cluster sitting just above the lid of the “Teapot” pattern of stars in Sagittarius. You then know to point your telescope in that direction to home in on the cluster, which happens to be 6.9-magnitude Messier 28 (M28).

You can see a great number and variety of astronomical objects with your AstroView 120ST, including:

A. The Moon

With its rocky, cratered surface, the Moon is one of the easiest and most interesting targets to view with your telescope. The best time to observe our only natural satellite is during a partial phase, that is, when the Moon is NOT full. During partial phases, shadows on the surface reveal more detail, especially right along the border between the dark and light portions of the disk (called the “terminator”). A full Moon is too bright and devoid of surface shadows to yield a pleasing view. Try using a Moon Filter to dim the Moon when it is very bright. It simply threads onto the bottom of the eyepieces (you must first remove the eyepiece from the star diagonal to attach the Moon filter).

B. The Sun

You can change your nighttime telescope into a daytime Sun viewer by installing an optional full-aperture solar filter over the front opening of the AstroView 120ST EQ. The primary attraction is sunspots, which change shape, appearance, and location daily. Sunspots are directly related to magnetic activity in the Sun. 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.

C. The Planets

The planets don’t stay put like the stars (they don’t have fixed R.A. and Dec. coordinates), so you’ll have to refer to charts published monthly at our website, www.telescope.com, or in monthly magazines like *Astronomy*, *Sky & Telescope*, to locate them. Venus, Mars, Jupiter, and Saturn are the brightest objects in the sky after the Sun and the Moon. Not all four of these planets are normally visible at any one time.

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 might 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.

D. Stars

Stars will appear like twinkling points of light in the telescope. Even powerful telescopes cannot magnify stars to appear as 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.

E. Deep-Sky Objects

Under dark skies, you can observe a wealth of fascinating deep-sky objects, including gaseous nebulas, open and globular star clusters, and different types of 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. Don’t expect these subjects to appear like the photographs you see in books and magazines; most will look like dim gray smudges. (Our eyes are not sensitive enough to see color in such faint objects.) But as you become more experienced and your observing skills get sharper, you will be able to discern more subtle details.

Remember that the higher the magnification you use, the dimmer the image will appear. So stick with low power when observing deep-sky objects, because they’re already very faint.

Consult a star atlas or observing guide for information on finding and identifying deep-sky objects. A good source to start with is the Orion DeepMap 600.

7. Astrophotography

Several different types of astrophotography can be successfully attempted with the AstroView 120ST:

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. Connect the T-ring to your camera body, and then thread the T-ring onto the rear of the focuser drawtube (remove the star diagonal first).

Now you’re 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.

This method of taking pictures is the same method with which a daytime, terrestrial photograph could be taken through the AstroView 120ST.

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 camera adapter to the T-ring, an eyepiece must be inserted and locked into the body of the camera adapter. Start by using a medium-low power eyepiece (about 25mm); you can increase the magnification later with a higher-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 thumb-screw.

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. 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 a 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), an 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 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 objective end of the telescope. Remove the tube rings from the equatorial mount and swap their positions, 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 telescope's star diagonal. 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 either 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. Terrestrial Viewing

The AstroView 120ST Refractor may also be used for long-distance viewing over land. For this application we recommend substitution of an Orion 45° Correct-Image Diagonal for the 90° star diagonal that comes standard with the telescope. The correct-image diagonal will yield an upright, nonreversed image and also provides a more comfortable viewing angle, since the telescope will be aimed more horizontally for terrestrial subjects.

For terrestrial viewing, it's best to stick with low powers of 50x or less. At higher powers the image loses sharpness and clarity. That's because when the scope is pointed near the hori-

zon, it is peering through the thickest and most turbulent part of the Earth's atmosphere.

Remember to aim well clear of the Sun, unless the front of the telescope is fitted with a professionally made solar filter and the finder scope is covered with foil or some other completely opaque material.

9. 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 cap on the front of the telescope when it is not in use.

Your AstroView 120ST telescope requires very little mechanical maintenance. The optical tube is aluminum 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 the Optics

A small amount of dust or a few specks on the glass objective (main) lens will not affect the performance of the telescope. If dust builds up, however, simply blow it off with a blower bulb, or lightly brush it off with a soft camel hair brush. Avoid touching optical surfaces with your fingers, as skin oil may etch optical coatings.

To remove fingerprints or smudges from a lens, use photographic-type lens cleaning fluid and lint-free optical lens cleaning tissue. Do not use household cleaners or eyeglass-type cleaning cloth or wipes, as they often contain undesirable additives like silicone, which don't work well on precision optics. Place a few drops of fluid on the tissue (not directly on the lens), wipe gently, then remove the fluid with a dry tissue or two. Do not "polish" or rub hard when cleaning the lens, as this will scratch it. The tissue may leave fibers on the lens, but this is not a problem; they can be blown off with a blower bulb.

Never disassemble the telescope or eyepieces to clean optical surfaces!

10. Specifications

Optical tube: Seamless aluminum

Objective lens diameter: 120mm (4.7")

Objective lens: crown and flint, achromatic, air-spaced, diffraction limited

Objective lens coating: fully coated with multi-coatings

Focal length: 600mm

Focal ratio: f/5

Eyepieces: 25mm and 10mm Plössls, fully coated, 1.25"

Magnification: 24x (with 25mm), 60x (with 10mm)

Focuser: Rack and pinion, accepts 1.25" or 2" accessories

Diagonal: 90° star diagonal, mirror type, 1.25"

Finder scope: 6x magnification, 30mm aperture, achromatic, crosshairs

Mount: German-type equatorial

Tripod: Aluminum

Motor drives: Optional

One-Year Limited Warranty

This Orion product 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. Proof of purchase (such as a copy of the original receipt) is required. This warranty is only valid in the country of purchase.

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. It is not intended to remove or restrict your other legal rights under applicable local consumer law; your state or national statutory consumer rights governing the sale of consumer goods remain fully applicable.

For further warranty information, please visit www.OrionTelescopes.com/warranty.



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