INSTRUCTION MANUAL

Orion® AstroView™ 102mm Equatorial Refractor Telescope

#55028

TELESCOPES & BINOCULARS
AN EMPLOYEE-OWNED COMPANY

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Congratulations on your purchase of an Orion telescope. . Your new AstroView 102mm Equatorial Refractor Telescope is a terrific instrument designed to provide outstanding views of celestial wonders. These instructions will help you set up, properly use, and care for your telescope. Please read them over thoroughly before getting started.

Table of Contents

I. Parts

Unpack all of the parts and lay them out on the floor. Make sure all the parts listed below and shown in **Figure 1** are present. Save the shipping box and packaging material. In the unlikely event that you need to return the mount, you must use the original packaging.

Part	**Qty**
A – Tripod	1
B – Equatorial mount	1
C – Accessory tray	1
D – Latitude adjustment T-bolt	1
E – Slow-motion cables	2
F – Counterweight shaft	1
G – Counterweight	1
H – Optical tube	1
I – EZ Finder II reflex sight	1
J – Star diagonal	1
K – 25mm Plossl eyepiece, 1.25"	1
L – 10mm Plossl eyepiece, 1.25"	1
M – Dust cover	1
N – MoonMap 260	1
O – Allen wrench	1

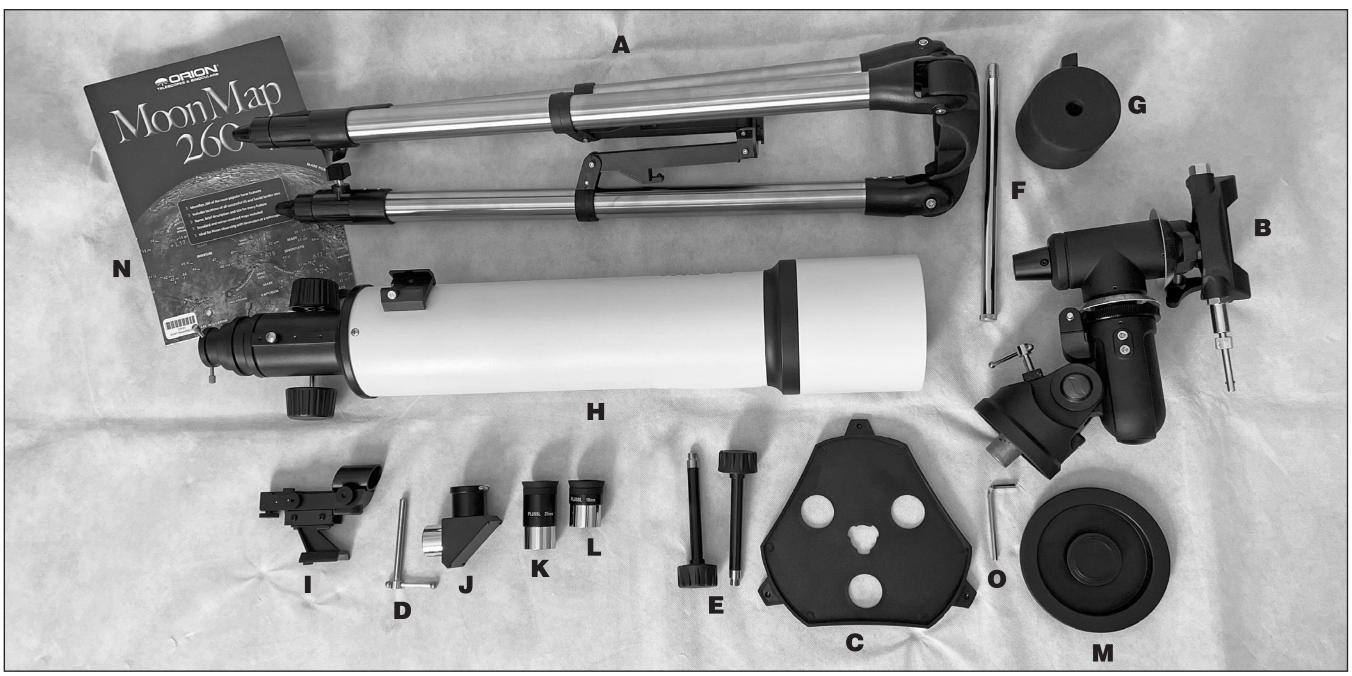

Figure 1. Components of the AstroView 102mm EQ Refractor

II. Assembly

1. Spread the tripod (A) legs apart and stand the tripod on the ground. You can extend the legs to the desired height later using the leg lock knobs. For now just keep them fully retracted.
2. Attach the accessory tray (C) by registering its center cutout over the center of the tripod leg brace assembly (**Figure 2A**). Press the tray down and twist it until the tray tabs click in place under the three retaining clips on the brace (**2B**).
3. Now you will attach the equatorial mount (B) to the tripod. Place the base of the mount onto the tripod's mounting platform, then turn the mount attachment knob clockwise until it's tight (**Figure 3**). This secures the equatorial mount to the tripod.
4. Next, thread the second latitude adjustment T-bolt (D) into the hole in the mount base. (One T-bolt comes pre-installed; the other one you must install yourself.) **Figure 3** shows the two installed latitude adjustment T-bolts.
5. Install the counterweight shaft (F) by threading it into the counterweight shaft collar (**Figure 4A**).
6. Now remove the safety stop at the end of the shaft and slide the counterweight (G) onto the shaft (**Figure 4B**). You may have to loosen the counterweight lock knob to allow the weight to slide onto the shaft. Once the counterweight is on the shaft, replace the safety stop.
7. Attach the two slow-motion cables (E) to the right ascension (RA) and declination (Dec) gear shafts by threading the collar on the gear shaft onto the cable until tight (**Figure 5**). You can see where they attach in **Figure 6**.

Before installing the optical tube on the mount, ensure that the RA and Dec lock knobs (**Figure 6**) are tightened so that the mount won't swivel accidentally when you're attaching the optical tube. And of course make sure the counterweight is installed on the counterweight shaft.

8. Make sure the two saddle clamp knobs are backed out sufficiently to allow the dovetail bar to seat properly. Then lift the optical tube (H) and set the dovetail mounting bar into the mount's saddle (**Figure 7**). When the dovetail bar is seated in the saddle, tighten the two saddle clamp knobs until tight.
9. Next, you will install the EZ Finder II Reflex sight (I). Slide the foot of the EZ Finder II into the dovetail mounting shoe as shown in **Figure 8**. Make sure the tab at the bottom of the bracket inserts snugly into the corresponding notch in the dovetail shoe. Then tighten the thumbscrew on the shoe. The EZ Finder II should be oriented so that the sight tube is facing the front of the telescope, as in **Figure 8**.

A star diagonal is used to divert the light at a right angle from the light path of the telescope. This allows you to observe in positions that are more comfortable than if you were to look straight through the telescope.

10. To attach the star diagonal (J), remove the protective dust cap from the 1.25" accessory adapter. Loosen the two thumbscrews on the adapter and slide the chrome portion of the star diagonal into it (**Figure 9**). Then retighten the thumbscrews to hold the star diagonal in place.

An eyepiece is the optical element that magnifies the image focused by the telescope. The eyepieces fit directly into the star diagonal.

11. To install one of the included eyepieces (K or L), loosen the thumbscrew on the star diagonal, then slide the chrome barrel of the eyepiece into it (refer to **Figure 10**). Then tighten the thumbscrew to hold the eyepiece in place.

CONGRATS! The telescope is now fully assembled. Before it can be effectively used, however, there are a couple of things to do to prepare the telescope for operation.

III. Preparing the Telescope for Operation

The 2" rack-and-pinion focuser of the AstroView 102mm EQ Refractor comes with a removable 1.25" step-down adapter installed (see **Figure 10**). This adapter allows use of the included 1.25" star diagonal and 1.25" eyepieces. Alternatively, one can also use an optional 2" diagonal and 2" eyepieces if so desired, simply by removing the 1.25" adapter (**Figure 11**). Doing so exposes the 2" accessory collar into which the optional 2" diagonal's barrel would be inserted. Some 2" eyepieces can have a wider apparent field of view than corresponding 1.25" eyepieces, and can have a larger eye lens. But 2" eyepieces are typically more expensive.

Aligning and Using the EZ Finder II Reflex Sight

The EZ Finder II (**Figure 12**) works by projecting a tiny red dot (it's not a laser beam) onto a tinted lens mounted in the front of the unit. When you look through the EZ Finder II, the red dot will appear to float in space, helping you locate your target object. The red dot is produced by a light-emitting diode (LED) near the rear of the sight. One 3-volt lithium battery provides the power for the diode.

In order to power the EZ Finder II for the first time, you must first remove the tab sticking out from the battery compartment. Just pull the tab out with your fingers, then discard it.

Now turn the power knob (see **Figure 12**) clockwise until you hear the "click" indicating that power has been turned on. Look through the back of the reflex sight with both eyes open to see the red dot. Position your eye at a comfortable distance from the back of the sight. In daylight you may need to cover the front of the sight with your hand to be able to see the dot, which is purposefully dim. The intensity of the dot is adjusted by turning the power knob. For best results when stargazing, use the

***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.**

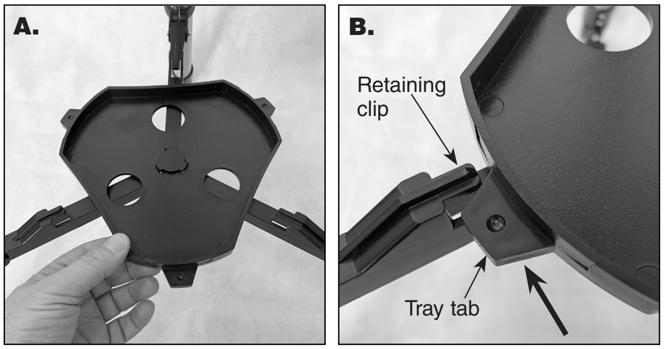

Figure 2. A) Place center of accessory tray over the center of the leg brace assembly. **B**) Press down and twist tray until the tabs click under retaining clips.

dimmest possible setting that allows you to see the dot without difficulty. Typically a dimmer setting is used under dark skies and a bright setting is used under light-polluted skies or daylight.

At the end of your observing session, be sure to turn the power knob counterclockwise until it clicks off. When the white dots on the EZ Finder II's body and power knob are lined up, the EZ Finder II is turned off.

Aligning the EZ Finder II

When the EZ Finder II is properly aligned with the telescope, an object that is centered on the EZ Finder II's red dot should also appear in the center of the field of view of the telescope's eyepiece. Alignment of the EZ Finder II is easiest to do during daylight, before observing at night.

Aim the telescope at a distant object such as a telephone pole or roof chimney and center it in the telescope's eyepiece. The object should be at least 1/4 mile away. Now, with the EZ Finder II turned on, look though the EZ Finder II. The object should appear somewhere in the field of view. Without moving the main telescope, use the EZ Finder II's azimuth (left/right) and altitude (up/down) adjust-ment knobs (see **Figure 12**) to position the red dot on the object in the eyepiece. When the red dot is centered on the distant object, check to make sure that the object is still centered in the telescope's field of view. If it is not, recenter it and adjust the EZ Finder II's alignment again. When the object is centered in the eyepiece and on the EZ Finder's red dot, the EZ Finder II is properly aligned with the telescope.

Once aligned, EZ Finder II will usually hold its alignment even after being removed and then re-installed in the dovetail base. Otherwise, only minimal realignment will be needed.

Balancing the telescope

To insure smooth movement of the telescope on both axes of the equatorial mount, it is imperative that the optical tube be properly balanced. First we'll balance the telescope with respect to the R.A. axis, then the Dec. axis.

1. While keeping one hand on the telescope optical tube (sold separately), loosen the R.A. lock knob (see **Figure 13A**). Make sure the Dec. lock knob 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), as in **Figure 13A**.

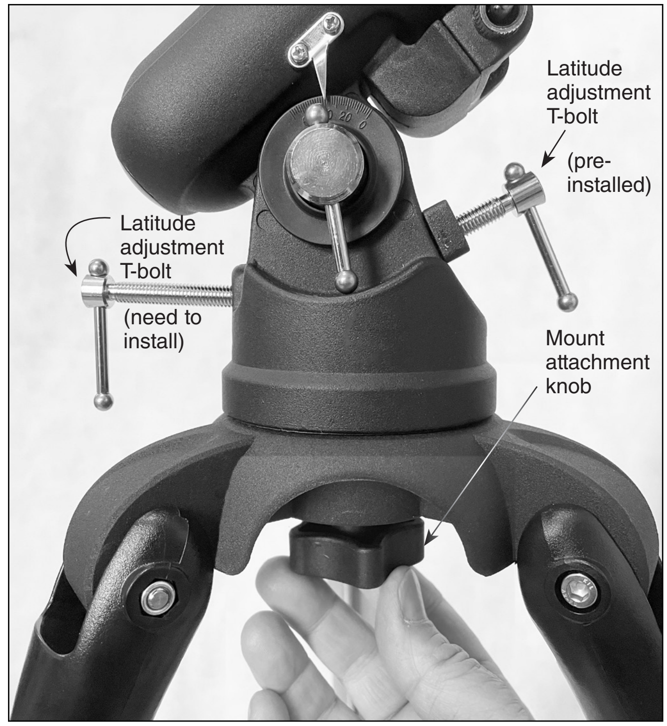

Figure 3. Secure the EQ mount to the tripod with the mount attachment knob.

2. Now loosen the counterweight lock knob and slide the weight along the shaft until it exactly counterbalances the telescope. That's the point at which the shaft remains horizontal even when you let go of the telescope with both hands.
3. Retighten the counterweight lock knob. 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 knob, with the counterweight shaft still in the horizontal position.
5. With one hand on the telescope optical tube, loosen the Dec. lock knob (see **Figure 13B**). The telescope should now be able to rotate freely about the Dec. axis. If the front of the telescope swings downward, that means you need to move it back in the mount's saddle. If the front of the telescope swings upward, then you need to shift the telescope forward in the saddle. To move the telescope in the saddle, loosen the saddle lock knobs just a little – so the dovetail bar doesn't accidentally pop out of the saddle. Position the telescope so it remains horizontal when you carefully let go with both hands. This is the balance point.
6. Retighten the saddle clamp knobs.

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

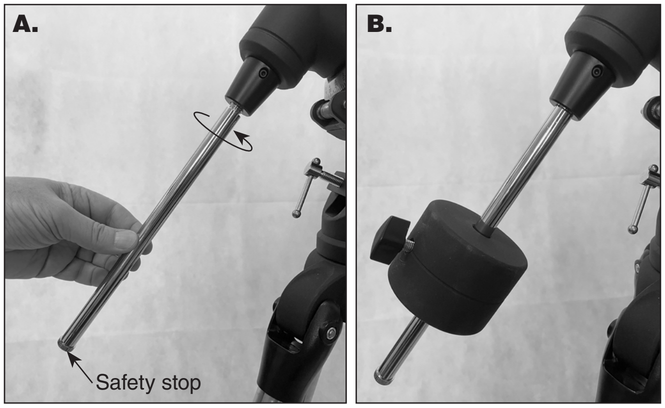

Figure 4. A) Thread the counterweight shaft onto the mount. **B**) After removing the safety stop, slide the counterweight onto the shaft.

IV. Understanding and Using the Equatorial Mount

When you look at the night sky, you no doubt have noticed 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 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.

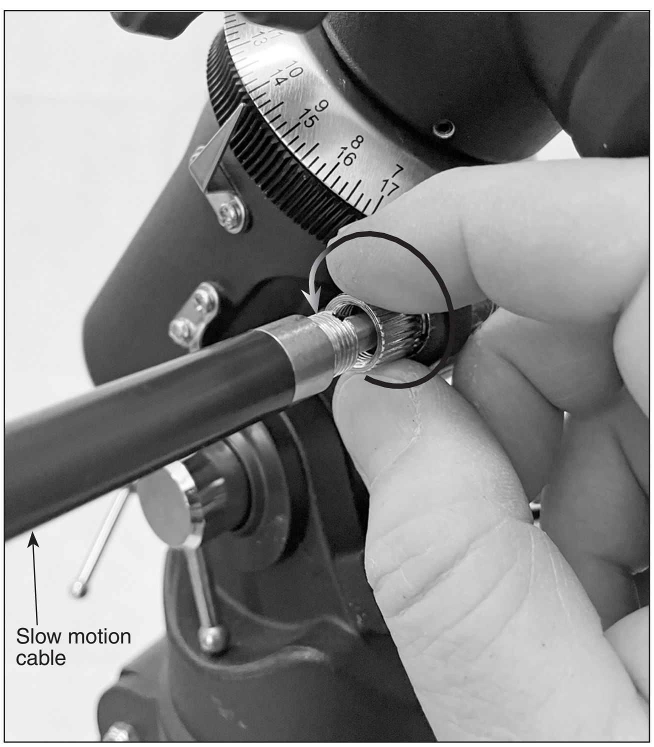

Figure 5. Attach the two slow-motion cables to the mount.

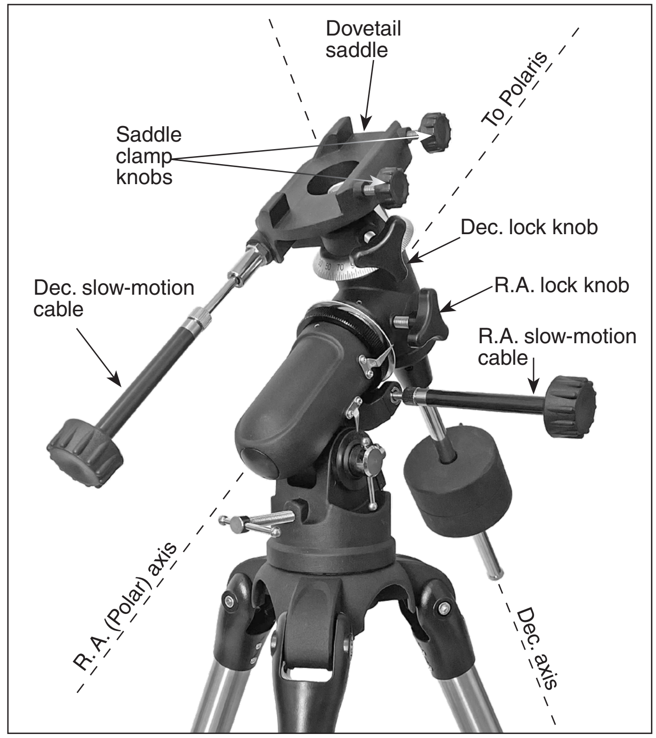

Figure 6. The assembled EQ-13 mount looks like this.

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 right ascension axis at the North Star, also known as Polaris (see **Figures 6 and 14**). 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 the NCP.

To find Polaris in the sky, look north and locate the pattern of the Big Dipper (**Figure 14**). The two stars at the end of the "bowl" of the Big Dipper point approximately 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).

To polar align the equatorial mount:

1. Roughly level the mount by adjusting the length of the three tripod legs as needed.
2. Loosen the latitude lock knob a half turn or so (**Figure 15**).
3. Using the two latitude adjustment T-bolts, set the latitude so that the pointer on the latitude scale indicates the latitude of your observing location. (Loosen one latitude adjustment T-bolt before tightening the other.) If you don't know your location's latitude, you can look it up on the internet. For example, if your latitude is 35° North, set the pointer to 35. Then retighten the latitude lock knob. The latitude setting

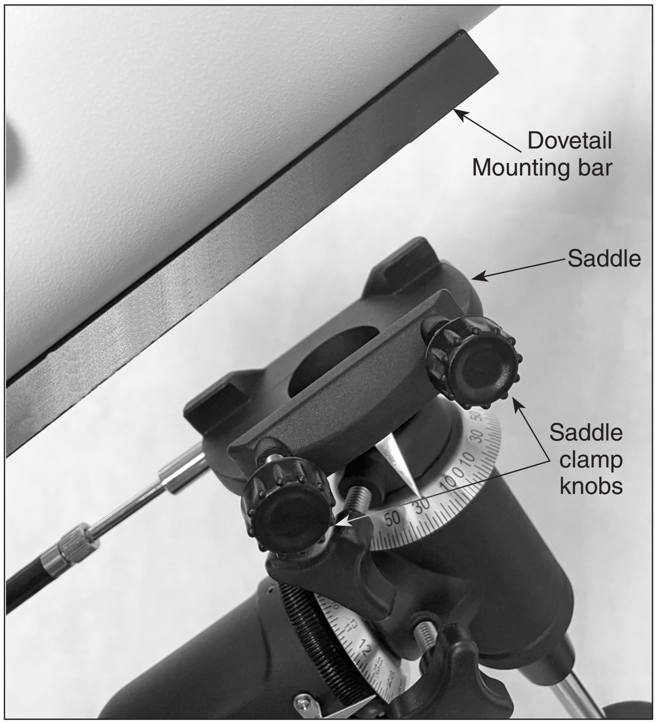

Figure 7. Install the optical tube on the mount by placing the dovetail bar into the saddle, then secure it by tightening the two saddle clamp knobs.

Figure 8. Attach the EZ Finder II by sliding the bracket it into the dovetail shoe as shown, then secure it with the thumbscrew on the shoe.

should not have to be adjusted again unless you move to a different viewing location some distance away.

4. Next, loosen the mount attachment knob (see **Figure 15**) just enough to allow you to rotate the mount in azimuth. Then rotate the mount by hand so the R.A. axis points roughly at Polaris (see **Figure 6**). If you cannot see Polaris directly from your observing site, consult a compass and rotate the mount so the telescope points North. Then retighten the mount attachment knob.

The equatorial mount is now (roughly) polar aligned. From this point on in your observing session, you should not make any further adjustments to the azimuth or the latitude of the mount, nor should you move the tripod. Doing so will ruin the polar alignment. The telescope should henceforth be moved only about its R.A. and Dec. axes.

Using the R.A. and Dec. Slow-Motion Control Cables

The R.A. and Dec. slow-motion control cables (see **Figure 6**) allow fine adjustment of the mount's position to center objects within the telescope's field of view. Before using the cables, manually "slew" the mount to point the telescope in the vicinity of the desired target. Do this by loosening the R.A. and Dec. lock knobs and moving the telescope about the mount's R.A. and Dec. axes. Once the telescope is pointed somewhere close to the object to be viewed, retighten the mount's R.A. and Dec. lock knobs.

The object should now be visible somewhere in the field of view of the telescope's finder scope of reflex sight. If it isn't, use the slow-motion controls to scan the surrounding area of sky. **Note: when using the slow motion cables, the R.A. and Dec lock knobs should be tightened, not loose.** When the object is visible in the EZ Finder II, use the slow-motion controls to center it. Now, look in the telescope's eyepiece and use the slow-motion controls to center it in the eyepiece.

The R.A. slow motion cable can turn the mount's R.A. axis a full 360 degrees. However, the Dec. slow-motion cable has a limited range of about 25 degrees. If you reach the end of the range

Figure 9. Insert the chrome barrel of the star diagonal into the 1.25" adapter's accessory collar, then secure it with the two thumbscrews.

Figure 10. Insert the eyepiece into the star diagonal and secure it with the thumbscrew.

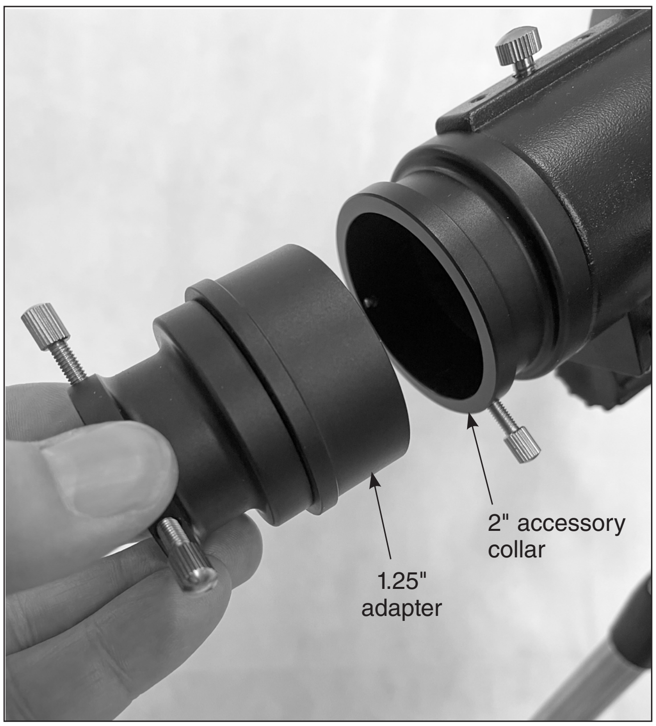

Figure 11. The 1.25" adapter can be removed from the 2" focuser, allowing use of an optional 2" diagonal and 2" eyepieces if desired.

of motion – and you cannot turn the knob further – you should reverse direction by 10 degrees or so, then release the Dec. lock knob and move the telescope by hand back to about where it was pointed before the slow-motion cable stopped turning. Now you should be able to use the slow motion cable again for fine pointing in either direction.

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, assuming the equatorial mount is polar aligned, just turn

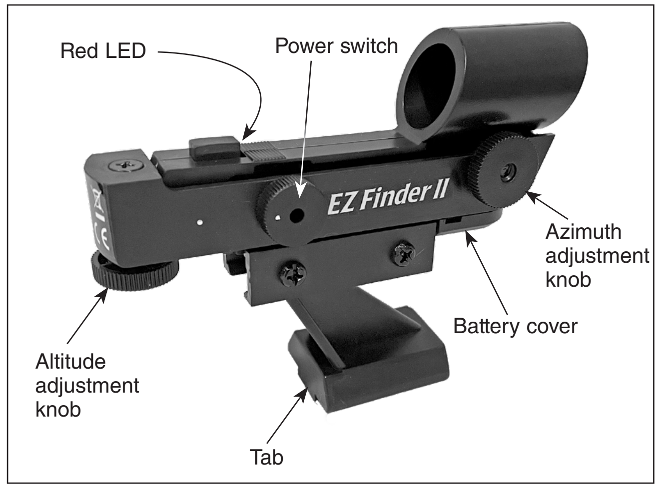

Figure 12. Features of the EZ Finder II.

the R.A. slow-motion control cable counterclockwise to track. The Dec. slow-motion control cable is not needed for tracking. Objects will appear to move faster at higher magnifications, because the field of view is narrower.

Optional Electronic Drive for Automatic Tracking

An optional DC electronic drive is available for the AstroView 102 EQ Refractor's equatorial mount. This battery-operated drive provides automated, hands-free tracking. Objects will then remain stationary in the field of view without any manual adjustment of the R.A. slow-motion control cable.

Understanding the Setting Circles

The two 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 online planetarium app.

On the AstroView 102 EQ Refractor's equatorial mount, the R.A. setting circle is scaled in hours, from 1 through 24, with small marks in between representing 10-minute increments (**Figure 16**). The numbers at the base of the setting circle scale apply to the Northern Hemisphere while the numbers above them apply to viewing in the Southern Hemisphere.

The Dec. setting circle is denoted in degrees, with each main mark representing 10° increments (**Figure 16)**. Values of Dec. coordinates range from +90° to -90°. The 0° mark indicates the celestial equator. For this mount, the number scale goes to 90 on either side of 0 – there are no (+) or (-) signs. When the telescope is pointed north of the equator, actual values of Dec. are negative.

For example, the coordinates for the Orion Nebula (M42) are:

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 polar aligned, and the setting circles must be calibrated. The easiest way to calibrate the setting circles is to point the telescope at an identifiable bright star, center it in the eyepiece, then set the setting circles to the star's published coordinates, which you can find in a star atlas or astronomical software program, or perhaps on the internet.

Calibrating the Right Ascension Setting Circle

1. Identify a bright star near the celestial equator (Dec. = 0°) and look up its coordinates in a star atlas.
2. Loosen the R.A. and Dec. lock knobs on the equatorial mount, so the telescope optical tube can move freely.
3. Point the telescope at the bright star near the celestial equator whose coordinates you know. Lock the R.A. and Dec. lock knobs. Center the star in the telescope's field of view with the slow-motion control cables.
4. Loosen the thumb screw located just above the R.A. setting circle pointer; this will allow the setting circle to rotate freely. Rotate the setting circle until the pointer indicates the R.A. coordinate listed in the star atlas for the object. Retighten the thumb screw.

Calibrating the Setting Circles

Using a star atlas or astronomy planetarium program, identify a bright star visible in your sky. Some smartphone astronomy apps allow you to hold your phone up to the sky and the app will identify the stars and constellations visible in the direction you're pointing to. Note the right ascension and declination coordinates of the star.

Let's take as an example Altair, in the constellation Aquila. Its coordinates are:

R.A. 19 hr 51 min, Dec 8° 52'

1. Loosen the R.A. and Dec. lock knobs on the equatorial mount, so the telescope optical tube can move freely.
2. Point the telescope at Altair. Lock the R.A. and Dec. lock knobs. Center the star in the eyepiece with the slow-motion control cables.
3. Rotate the R.A. setting circle until the metal pointer indicates 19 hr 51 min.
4. Then rotate the Dec. setting circle until the metal pointer indicates +8° 52'

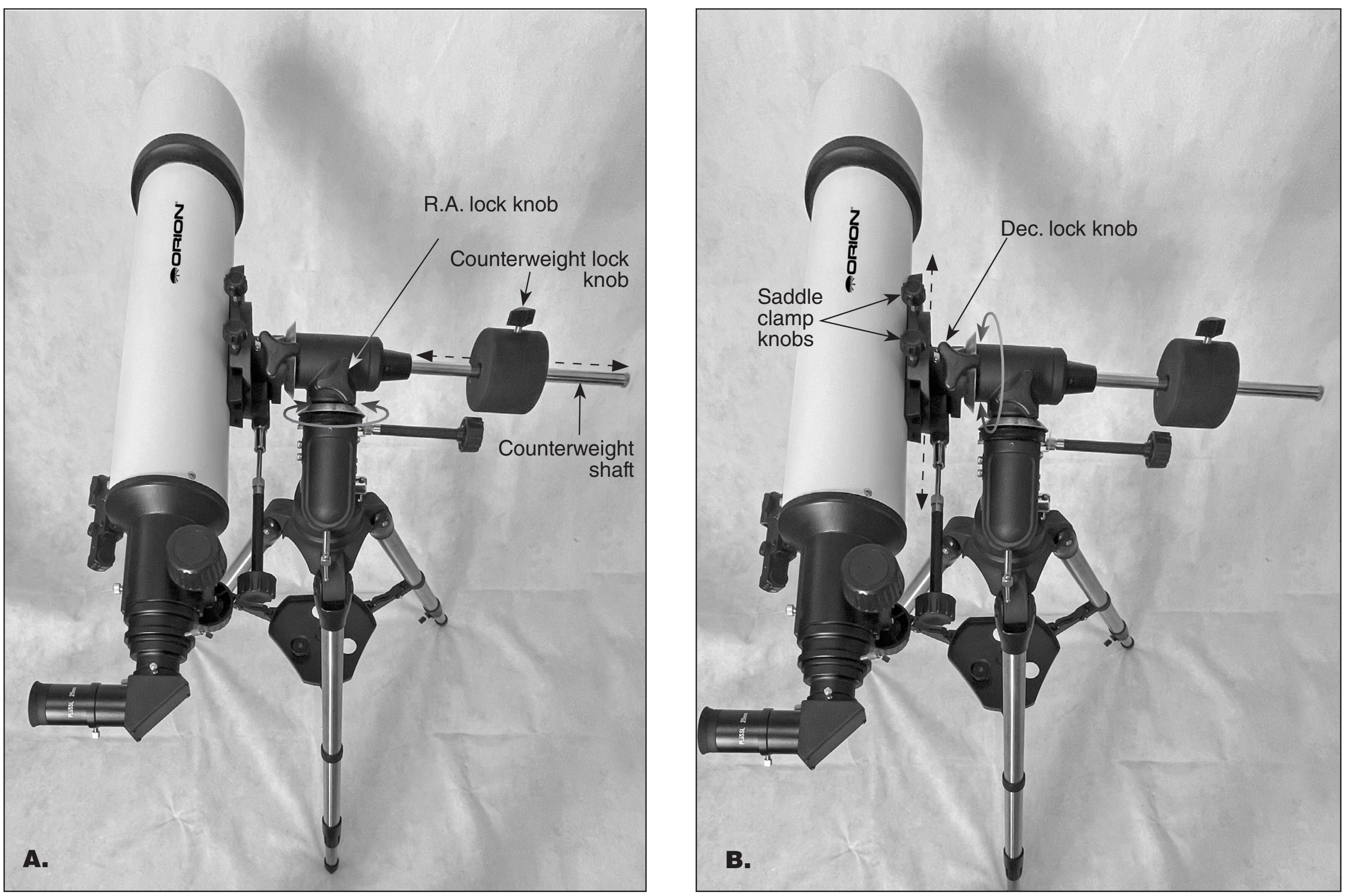

Figure 13. A) Balance a telescope in right ascension by sliding the counterweight along the shaft until it counterbalances the telescope. **B**) Balance the telescope on the declination axis by sliding the dovetail mounting bar forward or back in the mount's saddle.

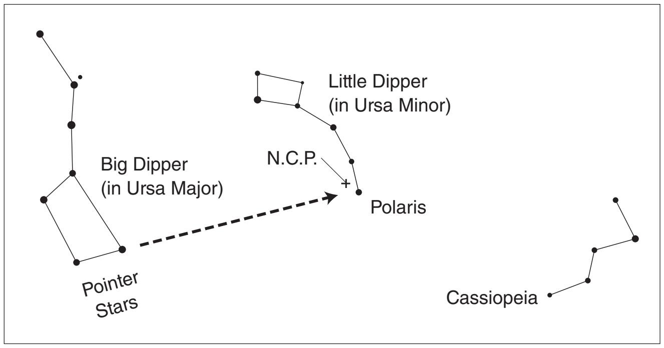

Figure 14. To find Polaris in the night sky, look north and find the Big Dipper. Extend an imaginary line from the two "Pointer Stars" in the bowl of the Big Dipper. Go about five times the distance between those stars and you'll reach Polaris, which lies within 1° of the north celestial pole (NCP).

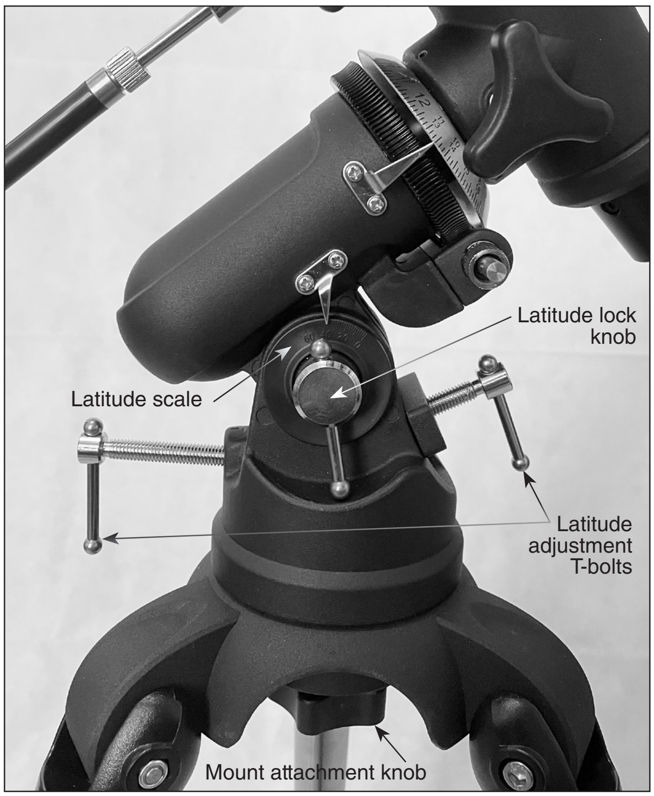

Figure 15. Loosen the latitude lock knob, then use the two latitude adjustment T-bolts to set the latitude scale pointer to your location's latitude.

Note that the setting circles may be a little hard to rotate. But just grab it firmly around the edge and twist it and it will rotate.

Finding Objects with the Setting Circles

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

1. Loosen the R.A. lock knob and rotate the telescope until the R.A. value from the star atlas matches the reading on

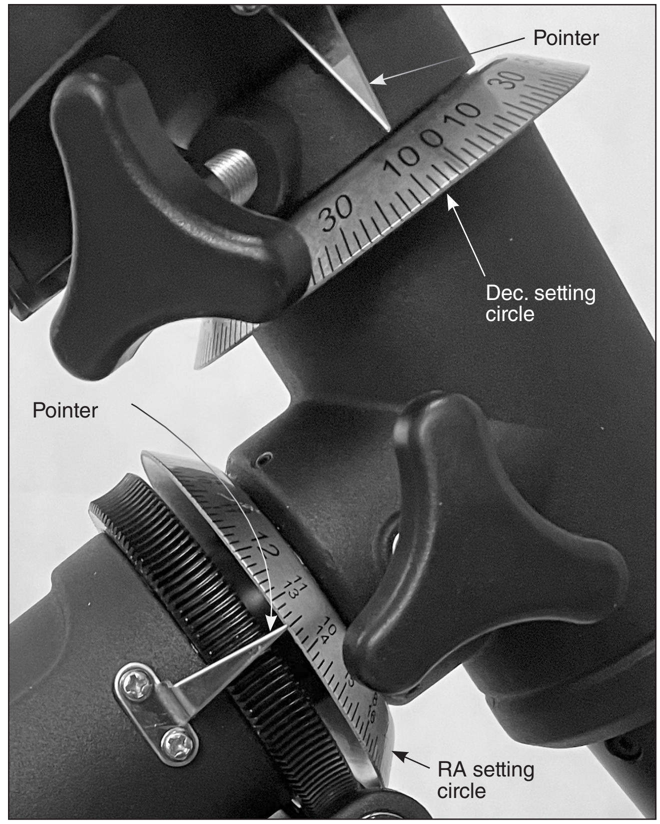

Figure 16. The R.A. and Dec. setting circles allow you to locate objects by their R.A. and Dec. coordinates.

the R.A. setting circle. Remember to use the lower set of numbers on the R.A. setting circle if you're in the Northern hemisphere. Retighten the lock knob.

2. Loosen the Dec. lock knob 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 knob.

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 or near 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.

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

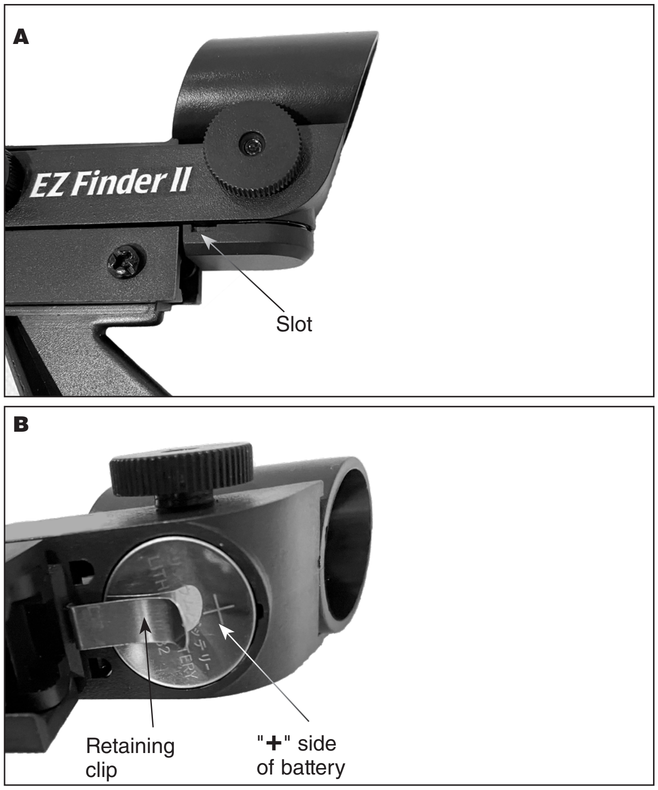

Figure 17. To change the battery, **A**) Pry the battery cover off by inserting a small flat-head screwdriver into the slot. **B**) Insert a CR3023 battery under the retaining clip, with positive "+" side facing the retaining clip. Then re-attach the battery cover.

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!

Confused About Pointing the Telescope?

Beginners occasionally experience some confusion about how to point the telescope overhead or in other directions. One thing you DO NOT do is make any adjustment to the mount's latitude setting or to its azimuth position. That will throw off the mount's polar alignment. Once the mount is polar aligned, the telescope should be moved only about the R.A. and Dec. axes. This is done by loosening one or both of the R.A. and Dec. lock knobs and moving the telescope by hand, or keeping the knobs tightened and moving the telescope using the slow-motion cables.

V. Astronomical Observing

For many, this will be your first foray into the exciting world of amateur astronomy. The following information and observing tips will help get you started.

Choosing an Observing Site

When selecting a location for observing, get as far away as possible from direct artificial light such as street lights, 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!

"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 you look up at the sky and stars are twinkling noticeably, the seeing is poor and you will be limited to viewing at lower magnifications. At higher magnifications, images will not focus clearly. Fine details on the planets and Moon will likely not be visible.

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.

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 (5th or 6th magnitude is desirable).

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 30 minutes for your telescope to acclimate to the temperature outdoors before you start observing with it.

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. Beware, too, that nearby porch, streetlights, and car headlights will ruin your night vision.

Eyepiece Selection

Magnification, or power, is determined by the focal length of the telescope and the focal length of the eyepiece being used. Therefore, by using eyepieces of different focal lengths, the resultant magnification can be varied. 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 and viewing conditions. Your AstroView 102 EQ comes with 25mm (L) and 10mm (M) Plossl eyepieces, which will suffice nicely to begin with. You can purchase additional eyepieces later if you wish to have more magnification options.

Magnification is calculated as follows:

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

For example, the AstroView 102 EQ Refractor has a focal length of 700mm, which when used with the supplied 25mm eyepiece yields:

$$\frac{700\text{mm}}{25\text{mm}} = 28\text{x}$$

The magnification provided by the 10mm eyepiece is:

$$\frac{700\text{mm}}{10\text{mm}} = 70\text{x}$$

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. Going beyond that will yield simply blurry, unsatisfactory views. The AstroView 102 EQ Refractor has an aperture of 102mm, or 4.0 inches, so the maximum magnification would be about 200x (4.0 x 50). This level of magnification assumes you have ideal atmospheric conditions for observing (which is seldom the case).

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!

Start by centering the object you wish to see in the 25mm eyepiece. Then you may want to increase the magnification to get a closer view, by switching to the 10mm eyepiece. 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. So make sure it is centered in the 25mm eyepiece before switching to the 10mm eyepiece.

Focusing the Telescope

To focus the telescope, turn the focus wheels (**Figure 10**) forward or back until you see your target object (e.g., stars, the Moon, etc.) in the eyepiece. Then make finer adjustments until the image is sharp. If you're having trouble achieving initial focus, rack the focuser drawtube all the way in using the focus wheels, then while looking into the eyepiece slowly turn the focus wheels so that the drawtube extends outward. Keep going until you see your target object come into focus. Note that when you change eyepieces you may have to adjust the focus a bit to get a sharp image with the newly inserted eyepiece.

If desired you can adjust the amount of focusing friction using the drawtube tension thumbscrew on the top of the focuser (see **Figure 10**). Rotate it clockwise to increase the tension; counter-clockwise to decrease it.

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 many bright deep-sky objects. Do not expect to see color as you do 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

Objects to Observe.

Now that you are all set up and ready to go, what is there to look at in the night sky?

A. The Moon

With its rocky surface, the Moon is one of the easiest and most interesting objects to view with your telescope. Lunar craters, maria, and even mountain ranges can all be clearly seen from a distance of 238,000 miles away! With its ever-changing phases, you'll get a new view of the Moon every night. The best time to observe our one and only natural satellite is during a partial phase, that is, when the Moon is not full. During partial phases, shadows are cast on the surface, which 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. Make sure to observe the Moon when it is well above the horizon to get the sharpest images.

Use an optional Moon filter to dim the Moon when it is very bright. It simply threads onto the bottom of the eyepieces. You'll find that the Moon filter improves viewing comfort, and helps to bring out subtle features on the lunar surface.

B. The Planets

The planets don't stay put like the stars, so to find them you should refer to the monthly star charts at OrionTelescopes.com, or to charts published monthly in Astronomy, Sky & Telescope, or other astronomy magazines. Venus, Mars, Jupiter, and Saturn are the brightest objects in the sky after the Sun and the Moon. Other planets may be visible but will likely appear star-like. Because planets are quite small in apparent size, optional higher-power eyepieces or a Barlow lens are recommended and often needed for detailed observations.

C. 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 telescope. 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 placed over the front aperture of your telescope, or permanent eye damage could result.

D. The Stars

Stars will appear like twinkling points of light. Even powerful telescopes cannot magnify stars to appear as more than a point 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 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 you find an observing site well away from light pollution.

To find deep-sky 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. A simple planisphere, or star wheel, can be a valuable tool for learning the constellations and seeing which ones are visible in the sky on a given night. Once you have identified a few constellations, a good star chart, atlas, or astronomy app will come in handy for helping locate interesting deep-sky objects to view within the constellations.

Do not expect these objects to appear like the photographs you see in books and on the internet; most will look like dim gray smudges. Our eyes are not sensitive enough to see color in deep-sky objects except in a few of the brightest ones. But as you become more experienced and your observing skills get sharper, you will be able to ferret out more and more subtle details and structure.

VI. Telescope 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 caps on the front of the telescope and on the focuser drawtube when not in use.

When bringing the telescope inside after an evening's viewing it is normal for moisture to accumulate on the lenses and mirrors due to the change in temperature. We suggest leaving the telescope and eyepieces uncovered overnight to allow the condensation to evaporate.

Cleaning the Telescope's Optics

Any quality optical lens cleaning tissue and optical lens cleaning fluid specifically designed for coated optics can be used to clean the lenses of your telescope and eyepieces. Never use regular glass cleaner or cleaning fluid designed for eyeglasses. Before cleaning, remove any loose particles or dust from the lens with a blower bulb or soft brush. 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 Lenses

Any quality optical lens cleaning tissue and optical lens cleaning fluid specifically designed for multi-coated optics can be used to clean the AstroView's objective lens or 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, 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. For the large surface of the objective lens, clean only a small area at a time, using a fresh lens tissue on each area. Never reuse tissues.

Replacing the EZ Finder II's Battery

Should the EZ Finder II's battery ever die, you will need to replace it with a fresh one. Replacement 3-volt lithium batteries (CR2032) are available from many retail outlets. Remove the old battery by inserting a small flat-head screwdriver into the slot on the battery cover (**Figure 17A**) and gently prying open the cover. Then carefully pull back on the retaining clip and remove the old battery. Do not over-bend the retaining clip! Then slide the new battery under the retaining clip with the positive (+) side facing the retaining clip (**Figure 17B**). Finally, replace the battery cover.

VII. Useful Optional Accessories

- Moon Filter – A 1.25" Moon filter will cut down the strong glare of sunlight reflected from the Moon, making Moon viewing more comfortable and revealing more surface detail. The filter threads into the bottom of the eyepieces that came with your telescope.
- Motor Drive – A motor drive, which attaches to the right ascension axis of an equatorial telescope mount, enables your telescope to "track" the motion of stars and other celestial objects as they drift slowly from east to west in the night sky. This keeps them in the eyepiece field of view indefinitely, instead of drifting out of sight.

- Barlow Lens – A 2x Barlow lens doubles the magnifying power of any eyepiece it's used with, giving you a big power boost to get in closer to your target object. You just insert it between the diagonal and the eyepiece.
- Planisphere – A nifty "star wheel" that shows what stars and constellations are visible in the sky at any time of any night. Just set the date and time see a mini representation of your local night sky. Great for identifying what you see and planning an evening's observing session.
- Star Map – More detailed than a planisphere, a star map is essential for locating interesting celestial objects to observe with your telescope. Nowadays many mobile astronomy apps feature customizable star maps that you can access on your smartphone or tablet while you're at the telescope.

VIII. Specifications

Lens aperture: 102mm (4.0")

Lens assembly: Achromatic doublet

Lens coating: Fully multi-coated

Focal length: 700mm

Focal ratio: f/6.9

Optical tube length: 26.5"

Focuser: 2" rack-and-pinion, accepts 2" and 1.25" accessories

Eyepieces: 25mm and 10mm Plossl, 1.25" barrel diameter, threaded for Orion filters

Eyepiece magnification: 28x (25mm eyepiece) and 70x (10mm eyepiece)

Finder scope: EZ Finder II reflex sight

Diagonal: 90-degree mirror star diagonal

Dew shield outer diameter: 5.0"

Mount: German equatorial

Counterweight: One, 5.8 lbs.

Mount saddle height with tripod legs retracted: 36.5"

Mount saddle height with tripod legs extended: 54"

Tripod: Stainless steel

Total instrument weight: 23 lbs., 9 oz.

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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