INSTRUCTION MANUAL

Orion ShortTube™ 80mm Equatorial Refractor

#52707

ORION
TELESCOPES & BINOCULARS
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IN 653 10/20

Congratulations on your purchase of an Orion telescope. Your new ShortTube 80 Equatorial Refractor is a terrific starter instrument for exploring the exotic wonders of the night sky. Designed to provide a wide field of view, sharp images, and excellent portability, the ShortTube 80 EQ will provide many hours of enjoyment for the whole family.

If you have never owned a telescope before, we would like 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. 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 fascination, 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.

Contents

WARNING: ***Do NOT look at the Sun without a professionally made* solar filter *on the telescope; serious eye damage may result if you look at the Sun with any unfiltered optical instrument. Do not leave the telescope unsupervised around children. Always cover the lenses when leaving the telescope in direct sunlight.***

Figure 1. Parts of the ShortTube 80EQ refractor

I. Included 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 telescope, you must use the original packaging. Initial assembly of the telescope is easy and should take only about 20 minutes.

	Part	Qty
A	Optical tube assembly with dust cover	1
B	Equatorial mount	1
C	Tripod legs	3
D	Counterweight	1
E	Accessory tray support bracket	1
F	Finder scope bracket with O-ring	1
G	Tube rings with mounting bolts	2
H	Accessory tray and wing nut screws	1
I	8x40 Finder scope	1
J	Star diagonal	1
K	25mm Sirius Plossl eyepiece	1
L	10mm Sirius Plossl eyepiece	1
M	Tripod leg mounting bolts and hardware	3
N	Tripod leg lock knobs	3
O	Slow-motion cables	2
P	Counterweight shaft	1
Q	Latitude adjustment T-bolt	1
R	Philips screwdriver	1
S	Assembly tool	1
T	Hex wrench	1
U	Orion DeepMap 600	1
V	Orion MoonMap 260	1

II. Assembly

Assembling the telescope for the first time should take about 30 minutes. No tools are needed other than the tools 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** and the parts list above during the assembly process.

1. Attach and tighten the leg lock knobs at the base of the three tripod legs (**Figure 2**).
2. Lay the equatorial mount on its side. Attach the tripod legs, one at a time to the base of the mount by sliding a tripod leg attachment bolt through the top of a leg and through the holes in the base of the mount. The washers should be on the outside of the tripod legs **(Figure 3**). Secure the wing nuts finger-tight. Note that the accessory tray bracket attachment screws on each leg should face inward.

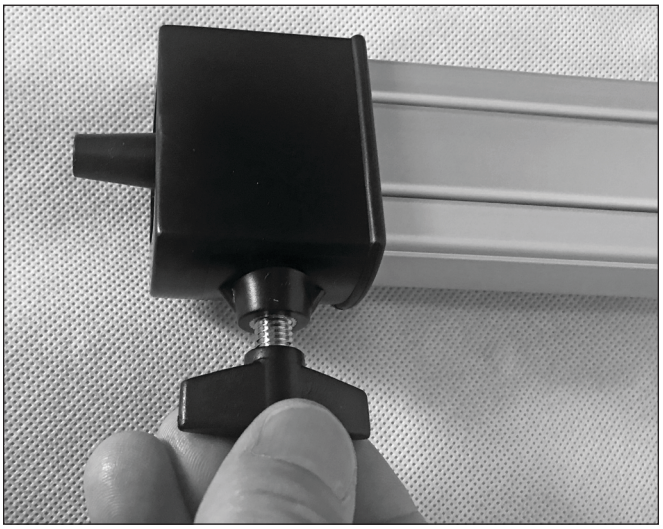


Figure 2. Attaching the leg lock knobs

Figure 3. Attaching the tripod legs to the base of the equatorial mount

Figure 4. Use the included Philips screwdriver and assembly tool to remove the bracket attachment screw

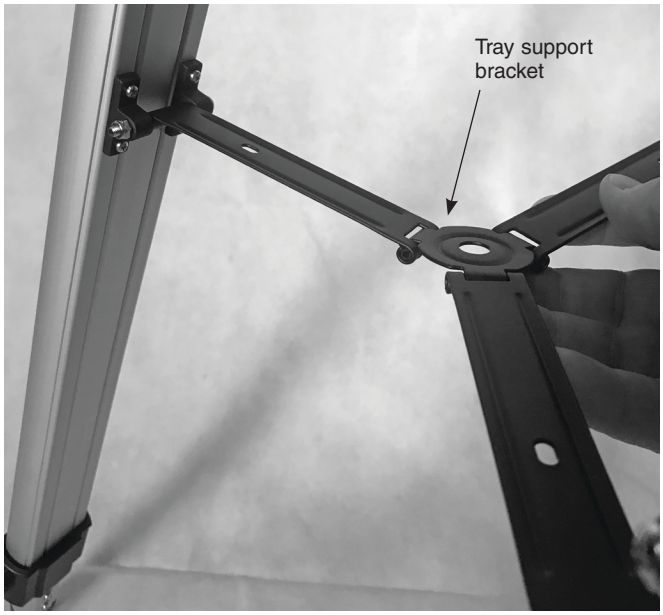


Figure 5. Attach the tray support bracket to each of the tripod legs

Figure 6. Attach the accessory tray to the support bracket using the three included wing nut screws as shown

3. With the tripod legs now attached to the equatorial mount, stand the tripod upright and spread the legs apart a bit. Now you will attach the accessory tray support bracket to the three corresponding bracket attachment screws on the legs. To do so first remove the screws using the included Philips screwdriver and the assembly tool as shown in **Figure 4**.
4. Now attach the bracket to each of the legs using the screws and nuts you just removed. Make sure the flat side of the bracket faces up (**Figure 5**).
5. Now spread the tripod legs apart as far as they will go, until the accessory tray bracket is taut. Then install the triangular accessory tray onto the bracket with the wing nut screws provided, as shown in **Figure 6**.
6. Thread the latitude adjustment t-bolt into the hole in the rear of the equatorial mount (**Figure 7**). Orient the mount so that the pointer next to the latitude scale is pointing roughly to the hash mark at 40°. To do this, loosen the latitude lock t-bolt (central to the latitude scale), and turn

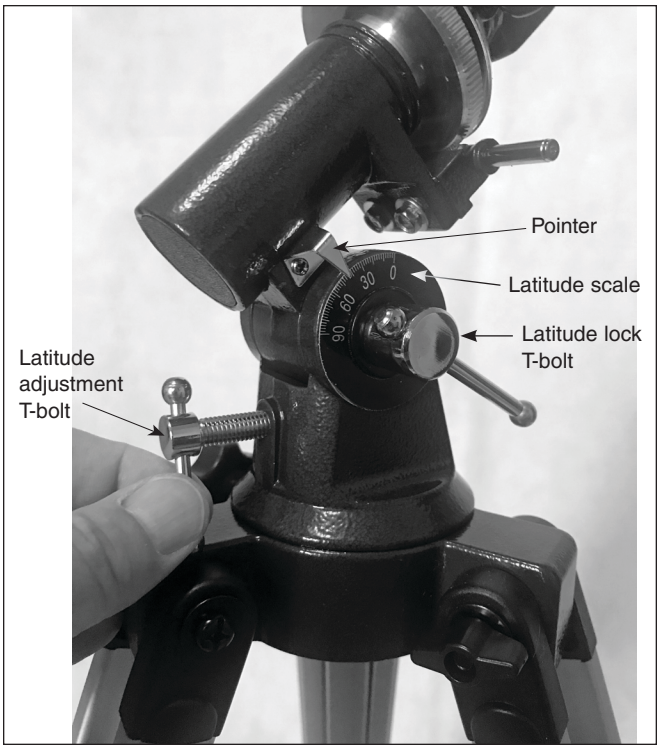


Figure 7. The latitude adjustment T-bolt goes into the threaded hole in the rear of the mount.

the latitude adjustment t-bolt until the pointer and the "40" line up. Then retighten the latitude lock t-bolt.

7. Slide the counterweight onto the counterweight shaft. Make sure the counterweight lock knob is adequately loosened so the counterweight shaft can pass through the hole in the counterweight.
8. With the counterweight lock knob still loose, grip the counterweight with one hand and thread the shaft into the equatorial mount (at the base of the declination axis) with the other hand (**Figure 8**). When it is threaded as far in as it will go, position the counterweight about halfway up the shaft and tighten the counterweight lock knob. The washer and screw on the end of the counterweight shaft will prevent the counterweight from slipping off the shaft and possibly onto your foot if the counterweight lock knob should loosen.
9. Now attach the two slow-motion cables to the R.A. and Dec. slow-motion shafts of the equatorial mount by positioning the thumbscrew on the end of the cable over the indented slot on the shaft, then tightening the thumbscrew (**Figure 9A**). We recommend the shorter cable be used on the R.A. worm gear shaft and the longer cable on the Dec. worm gear shaft, as shown in **Figure 9B**. The R.A. cable can be attached to either end of the R.A. shaft, whichever is most convenient for you.

The equatorial mount is now fully assembled, and should appear as in **Figure 10**. Next, we will attach the telescope tube rings followed by the telescope optical tube.

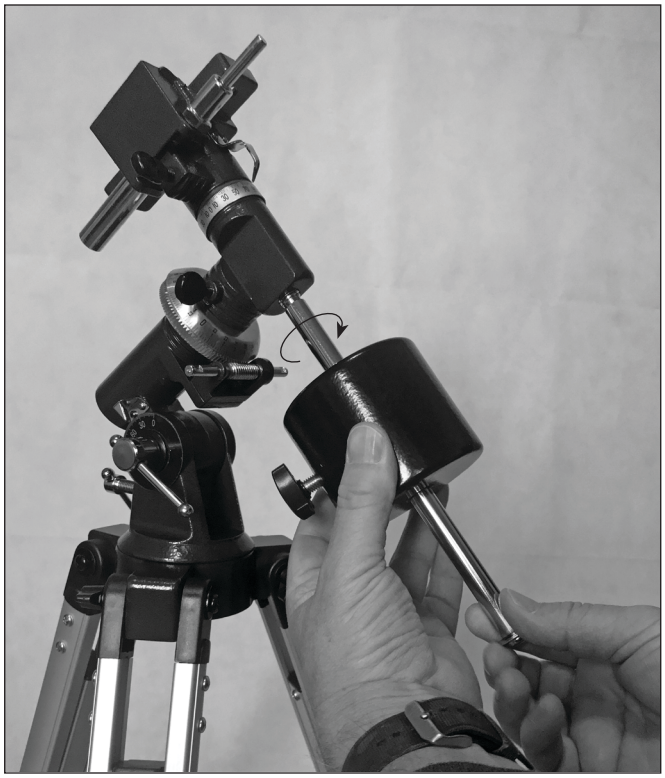


Figure 8. After sliding the counterweight onto the shaft, thread the shaft into its receptacle as shown

10. Attach each of the two tube rings to the equatorial mount using the hex head screws that come installed in the rings. Install the tube ring with the piggyback camera adapter in front of the other tube ring. Remove the screws, 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 (**Figure 11**). Tighten the screws securely with the included wrench. Now open the tube rings by loosening their knurled clamping knobs.
11. Lay the ShortTube 80 optical tube in the open tube rings as shown in **Figure 12**. Close the tube rings around the tube and tighten them with the clamping knobs.

Installing the Finder Scope

The ShortTube 80EQ comes with an 8x40 achromatic crosshair finder scope. The 8x40 descriptor means it has 8x magnifying power and a 40mm aperture.

Before you can attach the 8x40 finder scope, you must assemble it in its bracket.

12. Remove the rubber O-ring from the finder scope bracket and slide it over the finder scope tube. Then roll it into the narrow groove shown in **Figure 13A**.
13. Insert the finder scope tube into the bracket cylinder as shown in **Figure 13B**, making sure the two black alignment thumbscrews are backed out enough to allow clearance. Pull the metal spring pin back to allow the tube to insert until the O-ring seats inside the cylinder. Then

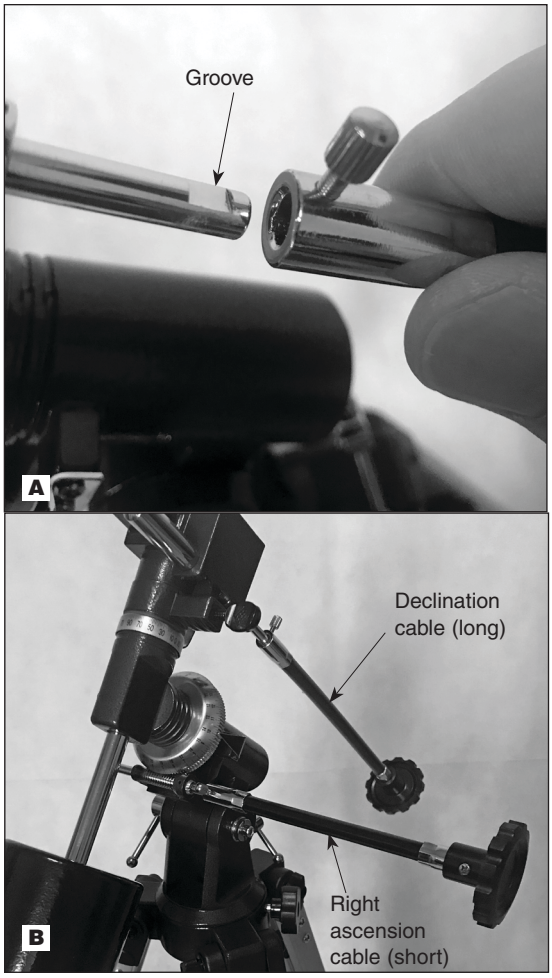


Figure 9. A) Attach the two slow-motion cables onto the declination and right ascension shafts by lining up the cable's thumbscrew with the flat groove on the shaft. **B**) The attached cables should appear as shown here.

Figure 10. The fully assembled EQ-1 equatorial mount.

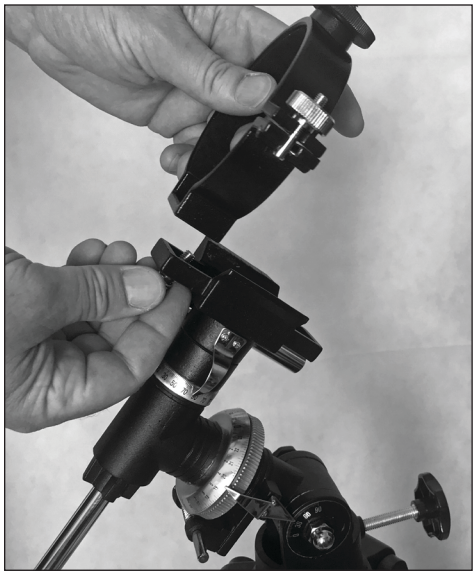
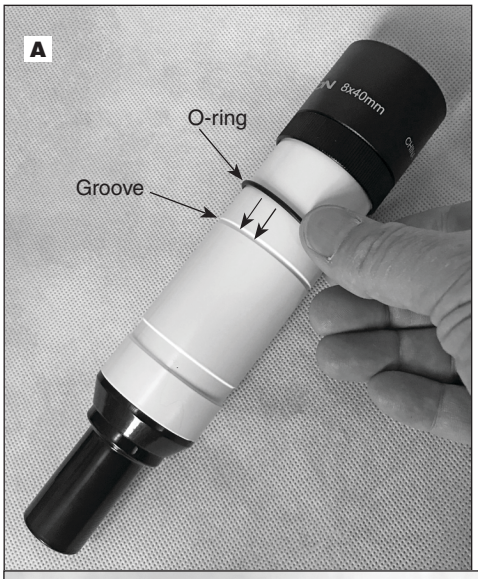


Figure 11. Attach the two tube rings to the equatorial mount's head, making sure the ring with the piggyback adapter on it goes in front.

Figure 12. Place the optical tube in the open tube rings, then close the rings and tighten the clamping knobs.



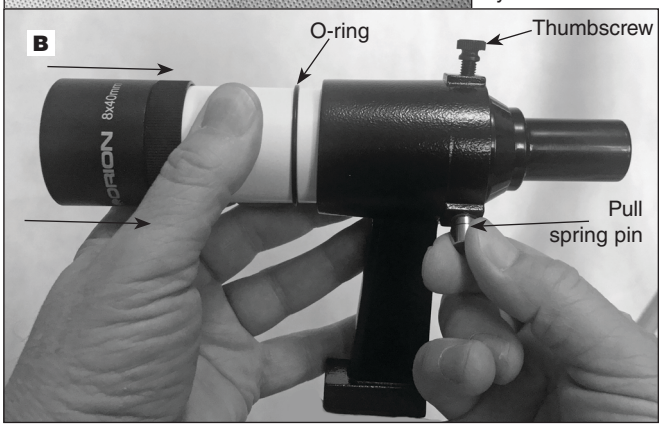


Figure 13. A) Place the rubber O-ring on the finder scope and push it into the groove. **B**) Slide the finder scope tube into the bracket as shown and, while pulling back the spring pin, push the tube until the O-ring seats just inside the bracket cylinder.

rotate the two black thumbscrews clockwise so that they push the tube into the center of the cylinder.

14. Now you can install the 8x40 finder scope on the optical tube by sliding the bracket foot into the dovetail shoe, as shown in **Figure 14**. Secure the bracket with the thumbscrew on the shoe.
15. Insert the star diagonal's chrome barrel into the drawtube collar, then tighten the two thumbscrews on the drawtube collar.
16. Then insert the 25mm eyepiece into the diagonal and secure it by lightly tightening the two thumbscrews on the diagonal (**Figure 15**).

Your ShortTube 80 EQ telescope is now completely assembled! Before jumping right in and starting to use it, however, there are a couple of things you should do first to prepare the telescope for operation.

III. Getting Started

The next things to do are to balance the telescope about its axes of motion, align the finder scope with the telescope, and focus the finder scope.

Balancing the Telescope

In order for the telescope to move smoothly on its mechanical axes, the optical tube should first be reasonably balanced on the mount as follows:

1. Keeping one hand on the telescope optical tube, loosen the R.A. clutch knob. Make sure the Dec. clutch knob is tight, 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 (**Figure 16**).
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. clutch knob, with the counterweight shaft still in the horizontal position.
5. With one hand on the telescope optical tube, loosen the Dec. clutch knob. The telescope should now be able to rotate freely about the Dec. axis (**Figure 16**). If the tube

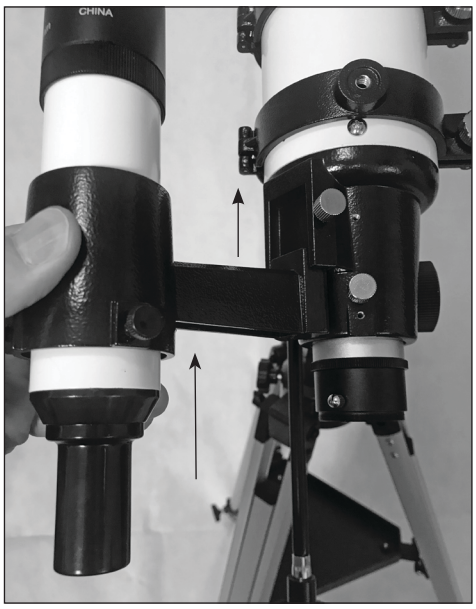


Figure 14. To install the finder scope, slide the bracket foot forward in the dovetail shoe, then tighten the thumbscrew on the shoe.

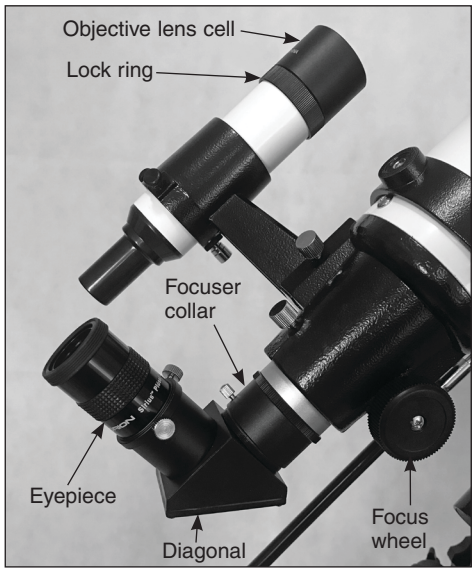


Figure 15. Install the diagonal and eyepiece in the focuser collar as shown.

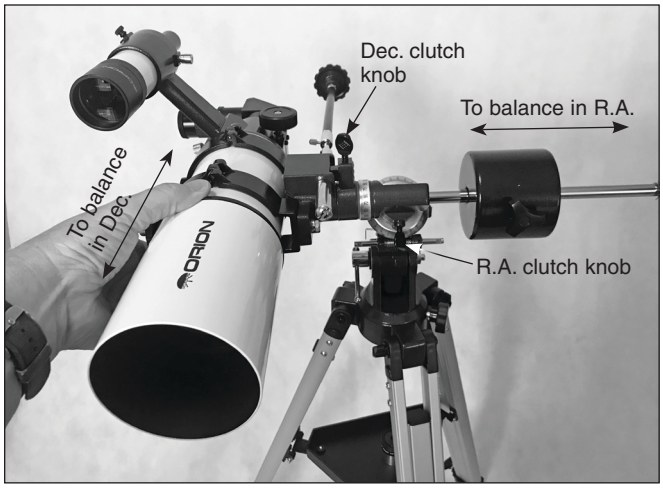


Figure 16. Balance the telescope on both the R.A. and Dec. axes so that it will not drift when pointed at a target.

rotates on its own due to imbalance, you will need to reposition it a little forward or back in the tube rings until it is balanced. (You'll have to loosen the clamp knobs a bit to do this. Note that for the ShortTube 80 there is not much room to move the telescope forward or back within the tube rings.) Then re-tighten the Dec. clutch knob.

The telescope is now balanced on both axes. Now when you loosen the clutch 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.

Image Orientation

The image in the telescope will appear reversed left to right. This is normal for astronomical telescopes that utilize a star diagonal. The finder scope view will appear rotated 180° (**Figure 17**).

Aligning the Finder Scope

A finder scope makes it easier to find the subject you want to observe in the main telescope. That's because the finder scope has a much wider field of view than that of the main telescope. Before you use the finder scope, it must be precisely aligned with the telescope, so they both point to exactly the same spot.

Alignment is easiest to do in daylight, rather than at night under the stars. First, insert the lowest-power (25mm) eyepiece into the telescope's focuser. Then point the 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 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 only fine adjustment of the two black

Naked-eye view

View through the ShortTube 80-A

View through finder scope

Figure 17. Images through the ShortTube 80 EQ with its star diagonal in place will be reversed from left-to-right. Images through the finder scope will appear upside-down and backwards (rotated 180°).

nylon alignment screws will be needed. Otherwise you'll have to make coarser adjustments to the alignment screws to redirect the aim of the finder scope. Use the two alignment screws to center the object on the crosshairs of the finder scope. Then look again into 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. Finder scopes can come out of alignment during transport of the telescope, so check the alignment before each observing session.

Focusing the Finder Scope

If, when looking through the finder scope, you notice that the images appear 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 15**). Back the lock ring off by a few turns, for now. Refocus the finder scope on a distant object by threading the objective lens cell in or out of the 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.

Piggyback Camera Adapter

The ShortTube 80 EQ comes with a piggyback camera adapter installed on one of the tube rings. It comprises a ¼"-20 post and a knurled disk. You can mount a DSLR or mirrorless camera equipped with a lens to ride "piggyback" on the ShortTube 80 to take wide-field photographs. To install the camera onto the piggyback adapter, set the ¼"-20 socket on the bottom of the camera onto the adapter's threaded post and rotate the camera a few turns. The rotate the knurled disk counterclockwise until it meets the camera bottom. Tighten the disk against the camera bottom.

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.

An equatorial mount has two perpendicular axes: right ascension and declination (**Figure 18**). The R.A. axis, also known as the "polar" axis, can be aligned to be parallel with the Earth's axis of rotation, thus allowing easy tracking of the night sky. This is accomplished by slowly rotating the telescope on its R.A. axis. The process of aligning the mount's R.A. axis with the Earth's rotational (polar) axis is 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 (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 the NCP.

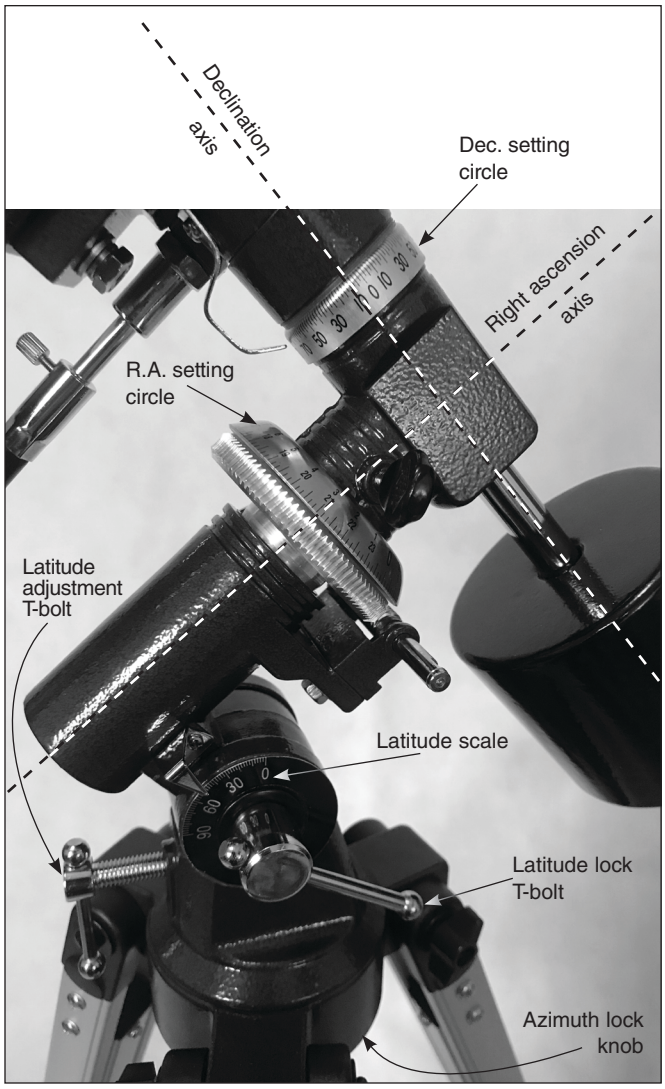


Figure 18. You can use the graduated setting circles to find celestial objects in the night sky.

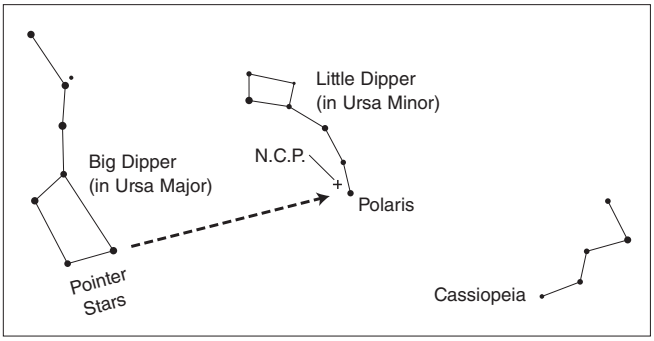


Figure 19. To find Polaris in the night sky, look north and find the Big Dipper. Extend an imaginary line from the two "Pointer Stars" in the bowl of the Big Dipper. Go about five times the distance between those stars and you'll reach Polaris, which lies within 1° of the north celestial pole (NCP).

To find Polaris in the sky, look north and locate the pattern of the Big Dipper (**Figure 19**). 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 ShortTube 80's equatorial mount:

1. Roughly level the equatorial mount by adjusting the length of the three tripod legs.
2. Loosen the latitude lock T-bolt. Turn the latitude adjustment T-bolt until the pointer on the latitude scale is indicating the latitude of your observing site. If you don't know your latitude, consult a geographical atlas or the internet to find it. For example, if your latitude is 35° North, set the pointer to 35. Then retighten the latitude lock T-bolt. 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. clutch knob 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. clutch knob.
4. Loosen the azimuth lock knob at the base of the equatorial mount (see **Figure 18**) and rotate the mount 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 mount so the telescope points North. Retighten the azimuth lock 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 undo the polar alignment.** The telescope should be moved only about its R.A. and Dec. axes.

Use of the R.A. and Dec. Slow-Motion Control Cables

The R.A. and Dec. slow-motion control cables allow fine adjustment of the telescope's position to center objects within the field of view. Before you can use the cables, you must 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 finder scope's field of view. If it isn't, use the slow-motion controls to scan the surrounding area of sky.

When the object is visible in the finder scope, use the slow-motion controls to center it on the crosshairs. Now, look in the telescope's eyepiece. If the finder scope is properly aligned, the object should be visible somewhere in the field of view of the eyepiece. Once the object is visible in the eyepiece, use the slow-motion controls to center it in the field of view.

The Dec. slow-motion control cable can move the telescope a maximum of 25°. This is because the Dec. slow-motion mechanism has a limited range of mechanical travel. (The R.A. slow-motion mechanism has no limit to its amount of travel.) If you can no longer rotate the Dec. control cable in a desired direction, you have reached the end of travel, and the slow-motion mechanism must be reset. This is done by first rotating the control cable several turns in the opposite direction from which it was being turned. Then, manually slew the telescope closer to the object you wish to observe (remember to first loosen the Dec. lock knob). You should now be able to use the Dec. slow-motion control cable again to fine adjust the telescope's position.

NOTE: *You can do the polar alignment with the telescope attached to the equatorial mount.*

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 your equatorial mount is polar aligned, just turn the R.A. slow-motion control cable clockwise. The Dec. slow-motion control cable is not needed for tracking; it is used as an aid in centering objects in the field of view. 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 can be mounted on the R.A. axis of the 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 cable.

Understanding the Setting Circles

The two setting circles (**Figure 18**) on an equatorial mount enable you to locate celestial objects by their "celestial coordinates". Every object resides in a specific location on the "celestial sphere". That location is denoted by two numbers: its right ascension (R.A.) and declination (Dec.). In the same way, every location on Earth can be described by its longitude and latitude. R.A. is similar to longitude on Earth, and Dec. is similar to latitude. The R.A. and Dec. values for celestial objects can be found in any star atlas or star catalog.

NOTE*: The setting circles on this ShortTube 80's equatorial mount are quite small, which means they will lack sufficient accuracy to pinpoint objects exactly based on their celestial coordinates. But they should get you fairly close.*

The mount's R.A. setting circle is scaled in hours, from 1 through 24, with small marks in between representing 10-minute increments. The numbers closest to the R.A. axis gear apply to viewing in the Southern Hemisphere, while the numbers above them apply to viewing in the Northern Hemisphere.

The Dec. setting circle is scaled in degrees, with each mark representing 2.5° increments. Values of Dec. coordinates range from +90° to -90°. The 0° mark indicates the celestial equator. When the telescope is pointed north of the celestial equator, values of the Dec. setting circle are positive, while when the telescope is pointed south of the celestial equator, values of the Dec. setting circle are negative.

So, the coordinates for the Orion Nebula 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 properly polar aligned, and the R.A. setting circle must be calibrated. The Dec. setting circle has been permanently calibrated at the factory, and should read 90° whenever the telescope optical tube is parallel with the R.A. axis.

Calibrating the Right Ascension Setting Circle

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

Finding Objects with the Setting Circles

1. Now that both setting circles are calibrated, look up in a star atlas the coordinates of an object you wish to view.
2. Loosen the R.A. lock knob and rotate the telescope until the R.A. value from the star atlas matches the reading on the R.A. setting circle. Remember to use the upper set of numbers on the R.A. setting circle. Retighten the lock knob.
3. 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 the field of view of the finder scope, assuming the equatorial mount is accurately polar aligned. Use the slow-motion controls to center the object in the finder scope, and it should appear in the telescope's field of view.

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

Confused About Pointing the Telescope?

Beginners occasionally experience some confusion about how to point the telescope overhead or in other directions. One thing you DO NOT do is make any adjustment to the mount's latitude setting or to its azimuth position (don't touch the azimuth lock knob). 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 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 ShortTube 80 EQ refractor comes with 25mm and 10mm Sirius 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:

Telescope Focal Length (mm) / Eyepiece Focal Length (mm) = Magnification

For example, the ShortTube 80 EQ has a focal length of 400mm, which when used with the supplied 25mm eyepiece yields:

400mm / 25mm = 16x

The magnification provided by the 10mm eyepiece is:

400mm / 10mm = 40x

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. Your ShortTube 80 telescope has an aperture of 80mm, or 3.1 inches, so the maximum magnification would be about 155x (3.1 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!

So start by using the 25mm eyepiece, then try switching to the 10mm eyepiece later if you want to boost the magnification.

Focusing the Telescope

The ShortTube 80 is outfitted with a 1.25" rack and pinion focuser. To focus the image you will use the black focus wheels (see **Figure 15**). Assuming you have installed a diagonal and eyepiece to acquire a target image, turn the focus wheels to rack the focuser drawtube in and out, changing the focal distance of the light path. To ensure the sharpest focus go slightly past your perceived focus point and then reverse directions until you have a sharp focus.

You will have to readjust the focus when aiming at subjects of varying distances, or after changing eyepieces. Make sure the drawtube tensioning thumbscrew is loosened before focusing. After focusing, you can tighten it to lock the telescope's focus into place if desired.

1.25" Drawtube Collar

The ShortTube 80's focuser drawtube is equipped with a 1.25" collar (see **Figure 15**) into which a diagonal or other 1.25" accessories are secured. The male threads on the end of the collar are T-threads (M42). Any accessory with a female T-thread such as many commercially available CCD and CMOS imagers and T-rings for SLR/DSLR camera bodies can be coupled to the ShortTube 80 by threading it directly onto the collar. This method is often preferred over inserting a camera's nosepiece barrel into the collar and securing it with the thumbscrews because thread coupling provides a firmer connection.

"Play" in the Focuser Drawtube? Here's How to Adjust it Out

If your telescope that has a little bit of "play", or looseness, in the focuser drawtube, rest assured that you can make a quick adjustment to remove it. Ideally, you don't want any drawtube play as it could produce some shifting of the image in the eyepiece as you rack the focuser in or out using the focus wheels. Such play could also throw a sharp image out of focus.

If you feel any wiggling of the drawtube in the focuser housing when you grab the end of the drawtube and tug it up and down, then do the following. You will need a 1.5mm metric Allen key to make this adjustment.

Locate the two tiny holes on the top of the focuser (**Figure 20**). Insert the end of a 1.5mm Allen key into the hole closest to the drawtube and turn the setscrew clockwise about 1/8 of a turn. Now try tugging the drawtube up and down again. Usually that 1/8 turn of tightening does the trick, but if there is still some looseness in the drawtube, tighten the setscrew another 1/8 turn. You could also try tightening the other setscrew 1/8 turn as well, but usually it only requires tightening one. You should only have to make this adjustment once.

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 such as star clusters and nebulas. Do not expect to see colors in faint objects as you do in photographs, however. Most galaxies and nebulas will appear gray in color. Unlike a camera, which can record colors of faint objects in long exposures, our eyes are not sensitive enough to see such color except in a few of the brightest ones.

Figure 20. To take out any "play" in the focuser drawtube, use a 1.5mm Allen wrench to lightly tighten the setscrews in the two holes indicated by the arrows.

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 must first remove the eyepiece from the focuser to attach a filter). 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.

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 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, 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.

VI. 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 constellations and planning an evening’s observing session.
- Smartphone Photo Adapter – Holds your smartphone up to the telescope’s eyepiece so you can take consistently sharp, well focused, high-magnification photos through the ShortTube 80.

VII. 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 okay. Small components like eyepieces and other accessories should be kept in a protective box or storage case. Keep the dust cover on the front of the telescope when it is not in use.

Your refractor telescope requires very little mechanical maintenance. The optical tube 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 household cleaning fluid.

Cleaning Optics

Any quality optical lens cleaning tissue and optical lens cleaning fluid specifically designed for multi-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.

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

VIII. Specifications

Objective lens:	80mm (3.1") diameter, achromatic
Focal length:	400mm
Focal ratio:	f/5
Lens coatings:	Multi-coated
Focuser:	Rack-and-pinion, accepts 1.25" accessories
Eyepieces:	25mm and 10mm Sirius Plossl, 1.25" barrel diameter, threaded for Orion filters
Eyepiece coatings:	Multi-coated
Eyepiece magnification:	16x (with 25mm eyepiece) and 40x (with 10mm eyepiece)
Diagonal:	90-degree mirror diagonal, 1.25"
Finder scope:	8x40 achromatic
Mount:	EQ-1 German equatorial
Tripod:	Aluminum, channel-style legs
Motor drive:	Optional
Total assembled weight:	16.4 lbs.

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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