

## INSTRUCTION MANUAL

# Orion SkyQuest™ XT PLUS Dobsonians

#8985 XT6 PLUS, #8974 XT8 PLUS, #8987 XT10 PLUS



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**Figure 2.** SkyQuest XT PLUS telescopes come with a terrific selection of accessories.

**Figure 1.** The SkyQuest XT8 PLUS 8" Dobsonian

Welcome to an exciting new world of adventure! Your SkyQuest XT PLUS Dobsonian is a high-quality optical instrument designed to bring you dazzling views of the universe on any clear night. Easy enough for an absolute beginner to use, but powerful enough to please even experienced amateur astronomers, XT PLUS Dobs will provide years of fun discovery for the entire family. They're packed with great features and useful accessories to insure your enjoyment of these wonderfully capable telescopes. Before venturing into the night with your new telescope, however, please follow this instruction manual carefully in order to properly assemble the telescope.

## 1. Unpacking

The telescope will arrive in two boxes, one containing the optical tube assembly and accessories, the other containing the unassembled Dobsonian base. Be careful unpacking the boxes; we recommend keeping them. In the event that the telescope needs to be shipped to another location, or returned to Orion for warranty repair, having the proper shipping boxes will help ensure that your telescope will survive the journey intact.

Make sure all the parts in the Parts List below are present. Be sure to check the boxes carefully as some parts are small. It is possible that one or more parts will be found in the box other than the one it's listed in. If anything appears to be missing or broken, immediately call Orion Customer Support (800-676-1343) for assistance.

## Parts List

### Box #1: Optical Tube Assembly and Accessories

Qty.	Description
1	Optical tube assembly
1	Dust cover
1	10mm Sirius Plössl eyepiece, 1.25" barrel diameter
1	25mm Sirius Plössl eyepiece, 1.25" barrel diameter (XT6 PLUS only)
1	28mm DeepView 2" eyepiece (XT8 and XT10 PLUS)
1	EZ Finder II with bracket
1	Shorty 2x Barlow lens
1	Safety Film solar filter
1	Quick-collimation cap
1	Eyepiece rack with two 1/2" mounting screws
2	Altitude axis coupling knobs
1	Low-friction washer (white, 9mm center hole)
1	Metal washer
1	Starry Night software digital download insert

### Box #2: Dobsonian Base

Qty.	Description
1	Left panel
1	Right panel
1	Front brace
1	Top baseplate (round)
1	Ground baseplate (triangular)
12	Base assembly screws (length 2")
3	Plastic feet
3	Wood screws (length 1", for feet)
1	Azimuth axis center bolt, hex head, 3" length
2	20mm diameter washers
4	Bearing cylinders
4	Bearing cylinder machine screws
1	3/8" lock nut
1	Nylon spacer washer (white)
3	Nylon bushings (black) – 17mm, 25mm or 29mm, 33.75mm length
1	Handle
2	Hex-head bolts, 32mm length (for Handle)
2	16mm diameter washers (for Handle)
2	Open-end wrenches
2	Hex keys – size 4mm and 2.5mm (2.5mm for XT8 and XT10 PLUS)

**WARNING:** *Never look directly at the Sun with the naked eye or with a telescope – unless you have a proper solar filter installed over the front of the telescope! Otherwise, permanent, irreversible eye damage may result.*

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## 2. Telescope Assembly

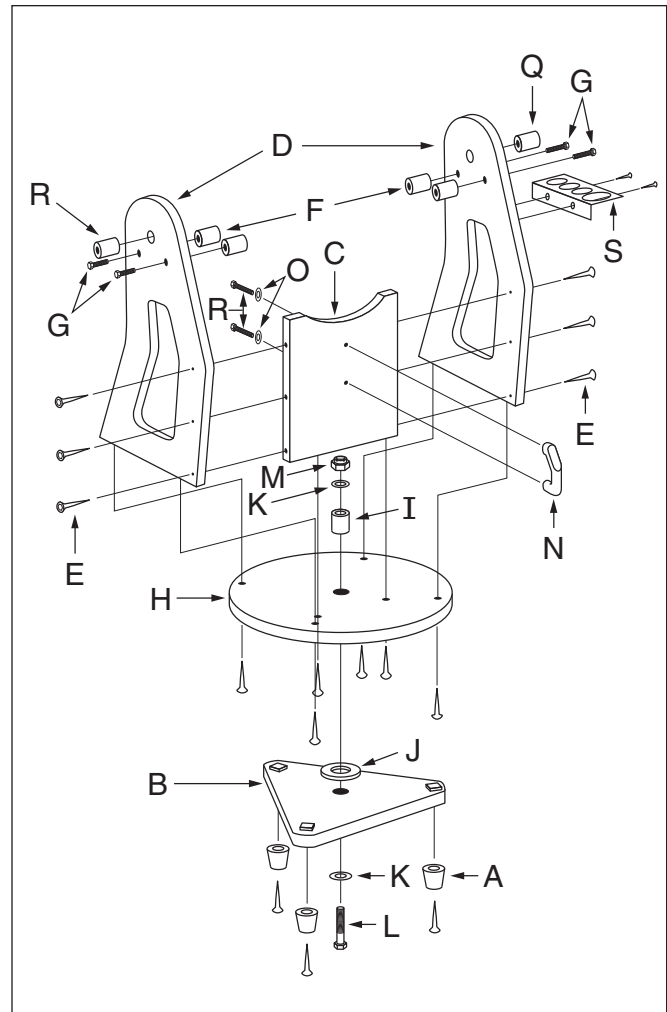
### Assembly of the Dobsonian Base

Now that you have unpacked the boxes and familiarized yourself with all the parts in front of you, it's time to begin assembly. The optics of the telescope are already installed in the tube, so most of the required assembly concerns the Dobsonian base.

Refer to **Figure 3** during base assembly. The base needs to be assembled only once, unless you disassemble it for long-term storage. The assembly takes about 30 minutes and requires a Phillips screwdriver, two included crescent wrenches, and the included hex key(s).

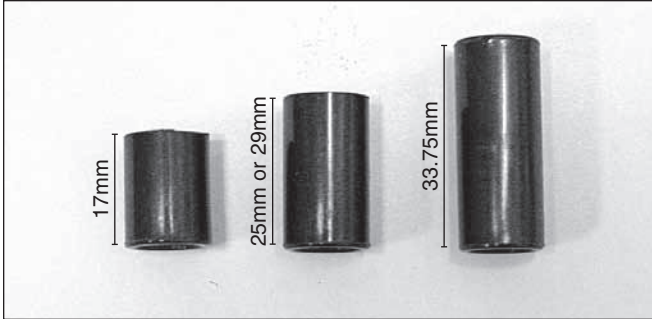
**Note:** When tightening the base assembly screws, tighten them until firm, but be careful not to strip the holes by over-tightening. If you use an electric screwdriver, do the final tightening with a standard screwdriver to avoid stripping.

1. Screw the plastic feet (A) into the underside of the bottom (triangular) groundplate (B) using the self-tapping wood screws provided, with a Phillips screwdriver. Insert the screws through the feet and thread them into the predrilled starter holes until tight.
2. Loosely attach the front brace (C) to the two side panels (D) with six of the black base assembly screws (E) in the predrilled holes. Use the 4mm hex key to tighten the screws. The side panels should be oriented so the "SkyQuest XT PLUS" label is facing outward. Do not completely tighten the screws yet.
3. Line up one of the altitude bearing cylinders (F) with one of the four bearing cylinder holes on the inside surface of each side panel. Push a bearing cylinder screw (G) through the side panel from the outside and thread the bearing cylinder onto it. You can tighten the cylinder by hand or, if needed, with the supplied 4mm hex key. Repeat for the remaining three bearing cylinders.
4. Attach the side and front panel assembly to the top groundplate (H) with the remaining six base assembly screws in the predrilled holes. Tighten all six screws.
5. Tighten the six side panel screws installed earlier.
6. Turn the base on its side. Insert the longest (33.75mm) of the three black plastic bushings (I, see **Figure 4**) into the hole in the center of the top groundplate (D). Push the bushing in so it goes all the way into the groundplate, sticking out from the bottom surface (**Figure 5**).
7. Now place the white low-friction spacer washer (J) on the portion of the bushing sticking out from the bottom (**Figure 5**).
8. Install the bottom groundplate (B) by lining up its center hole with the nylon bushing. The white low-friction spacer

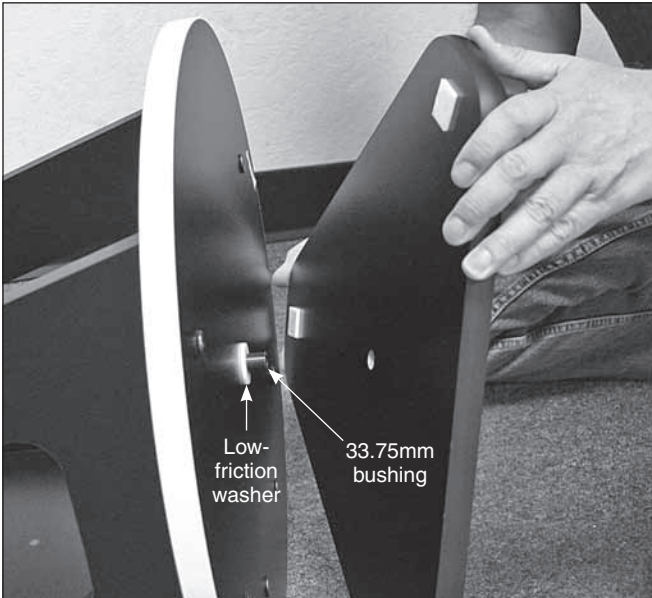


**Figure 3.** Exploded view of the XT PLUS Dobsonian base assembly.

9. Put one metal washer (K) onto the hex head bolt (L), then insert the bolt through the bushing in the center of the groundplates from the bottom, as shown in **Figure 3**.
10. Now place the remaining metal washer (K) on the bolt, followed by the lock nut (M). Use the two crescent wrenches provided to turn the lock nut with one wrench while holding the hex bolt's head with the other, or vice versa (**Figure 6**). Tighten the lock nut just enough to allow a slight separation of the top and bottom groundplates when the mount is lifted. The purpose of the lock nut is merely to keep the two groundplates from coming apart when moving the telescope. **Over-**



**Figure 4.** Three plastic bushings used in the assembly of the XT PLUS.



**Figure 5.** Assembly of the groundplates.

***tightening the lock nut will make the base difficult to rotate in the azimuthal (horizontal) direction.***

11. To attach the handle (N) to the front brace, first place a washer (O) onto each of the two 32mm hex-head bolts (P). Then insert the bolts through the holes in the front panel (from the inside surface) and into the threaded holes in the handle. Tighten the bolts with a crescent wrench.
12. In the hole near the top of the left side panel (C) insert the shortest (17mm) of the three black plastic bushings (Q). In the hole near the top of the right side panel (C) insert the middle-sized (25mm or 29mm) of the three black plastic bushings (R). The latter bushing (R) is longer than the width of the side panel by 1/4" or so – that's by design.



**Figure 6.** Use the two included open-end wrenches as shown to attach the bottom groundplate to the top groundplate.



**Figure 7.** Place the eyepiece rack's "keyholes" over the mounting screws, then press the rack downward and tighten the screws. (XT8 PLUS rack shown)

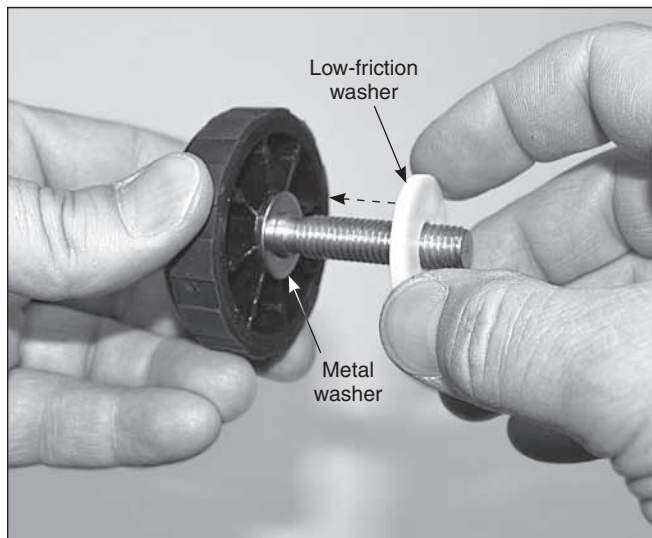
13. To install the eyepiece rack (S), find the two pilot holes on the left side panel, and screw one of the 1/2" wood screws into each hole until the screw heads are about 1/8" from the panel's surface. Then "keyhole" the eyepiece rack onto the wood screws and tighten the screws to secure the rack in place (**Figure 7**).



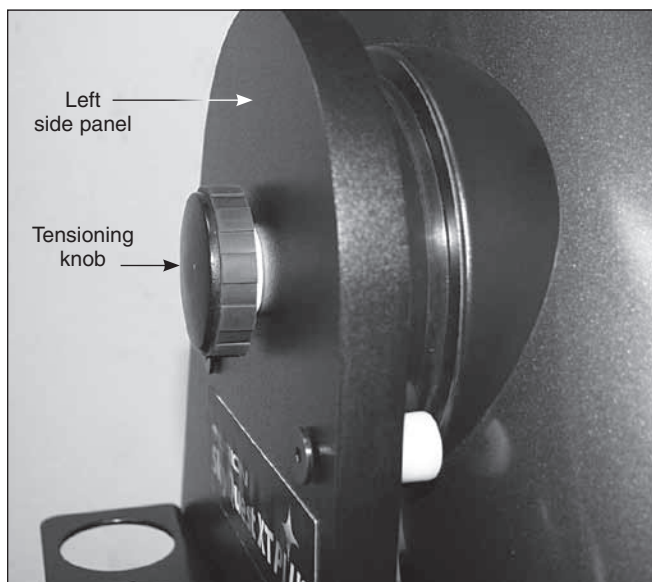
**Figure 8.** Gently set the telescope into the base by resting the side bearings of the telescope on the bearing cylinders.

#### Installing the Optical Tube Assembly on the Base

1. Lift the optical tube and gently place it into the Dobsonian base so that the altitude bearings on either side of the tube rest on the bearing cylinders (**Figure 8**). **Take care when lowering the telescope not to catch the ring of reddish material attached to the telescope tube's left side bearing on the top edge of the base's left side panel, or the ring could come off (it is held on the side bearing with adhesive).** Make sure the optical tube is oriented as shown, with the focuser facing the left side panel. Once the tube is resting on the bearing cylinders, the tube should pivot freely up and down with gentle hand pressure. Note that the tube will not yet be properly balanced, since the eyepiece and EZ Finder II are not in place, and the altitude axis coupling knobs are not yet installed.
2. Now insert the bolt of one of the altitude axis coupling knobs through the bushing in the RIGHT side panel and turn the knob to thread the bolt into the threaded insert

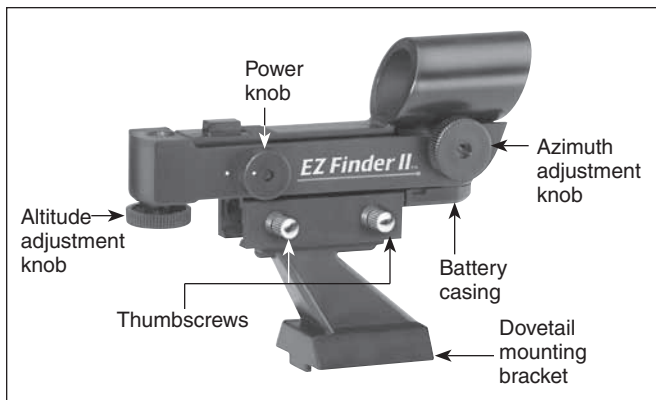


**Figure 9.** Assembling the tensioning knob. First place a metal washer on the bolt, then thread on the white, low-friction washer until it is all the way on. Both washers will now be held captive on the bolt.

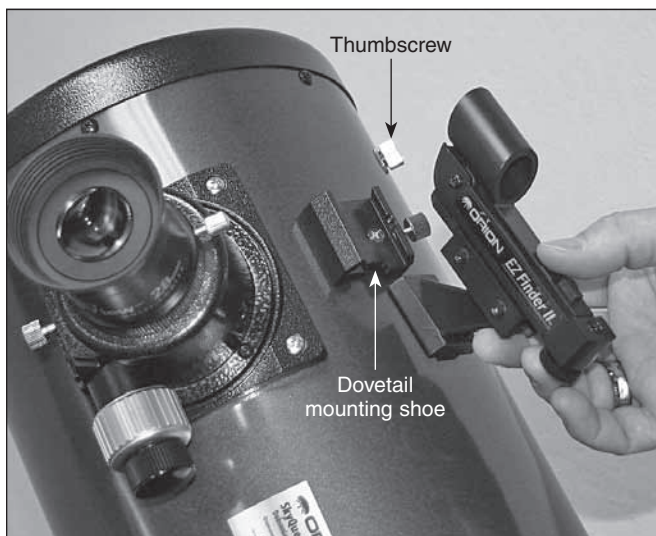


**Figure 10.** The tensioning knob on the left side panel lets you set and adjust the amount of friction for the altitude motion of the telescope.

- of the tube assembly's right side bearing. Thread the bolt until it stops and the knob is lightly tightened.
3. On the other altitude axis coupling knob place a metal washer on the bolt, then thread on the white plastic washer all the way (**Figure 9**), until it is captive on the smooth portion of the shaft nearest the hand knob. Now insert the bolt through the bushing on the LEFT side panel and use the knob to thread it into the left side bearing on the optical tube assembly. This coupling knob is referred to as the "tensioning knob" (**Figure 10**).



**Figure 11.** The EZ Finder II reflex sight.



**Figure 12.** Slide the EZ Finder II into the dovetail shoe and secure it with the thumbscrew. Note the correct orientation of the EZ Finder.

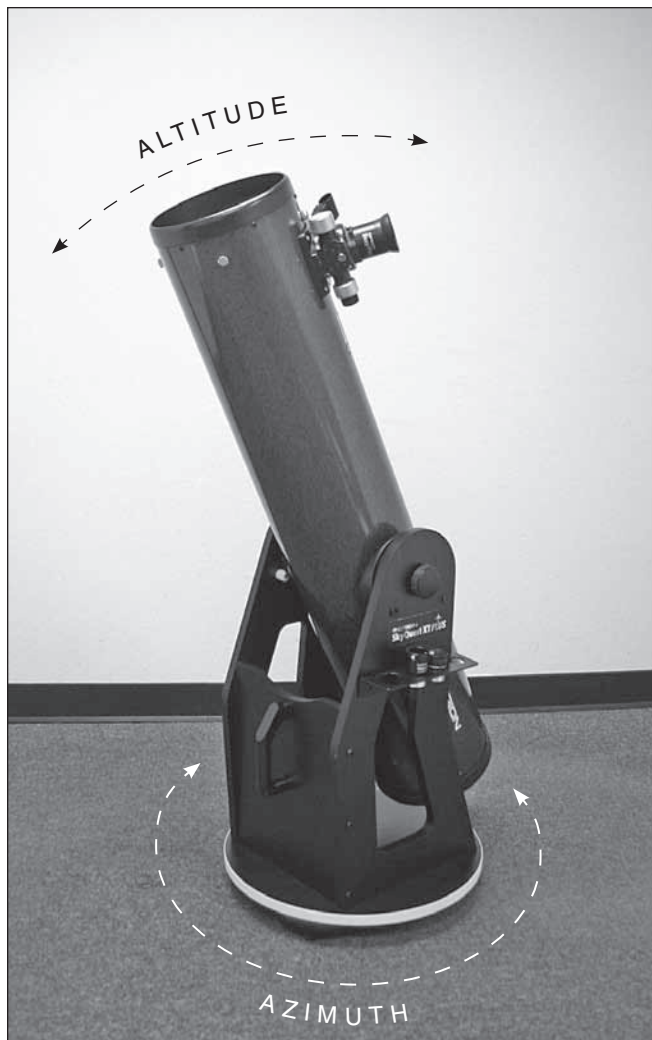
### Installing the EZ Finder II

Before installing the EZ Finder II on the telescope, you'll need to insert the included 3-volt lithium battery.

1. Insert a small, flat-blade screwdriver into the notch in the battery casing and gently pry it off (**Figure 11**).
2. Slide the CR2032 3V lithium battery under the retaining clip with the positive (+) side facing down (touching the clip).
3. Then press the battery casing back on.

Should the battery die, replacement CR2032 batteries are available at many stores where small batteries are sold.

To attach the dovetail mounting bracket to the EZ Finder II, loosen the two thumbscrews on the bottom rail of the EZ Finder II. Slide the EZ Finder II onto the bracket and tighten the two thumbscrews. Then simply slide the dovetail mounting bracket into the telescope's dovetail mounting shoe as shown in **Figure 12** and tighten the thumbscrew on the shoe to secure the mounting bracket.



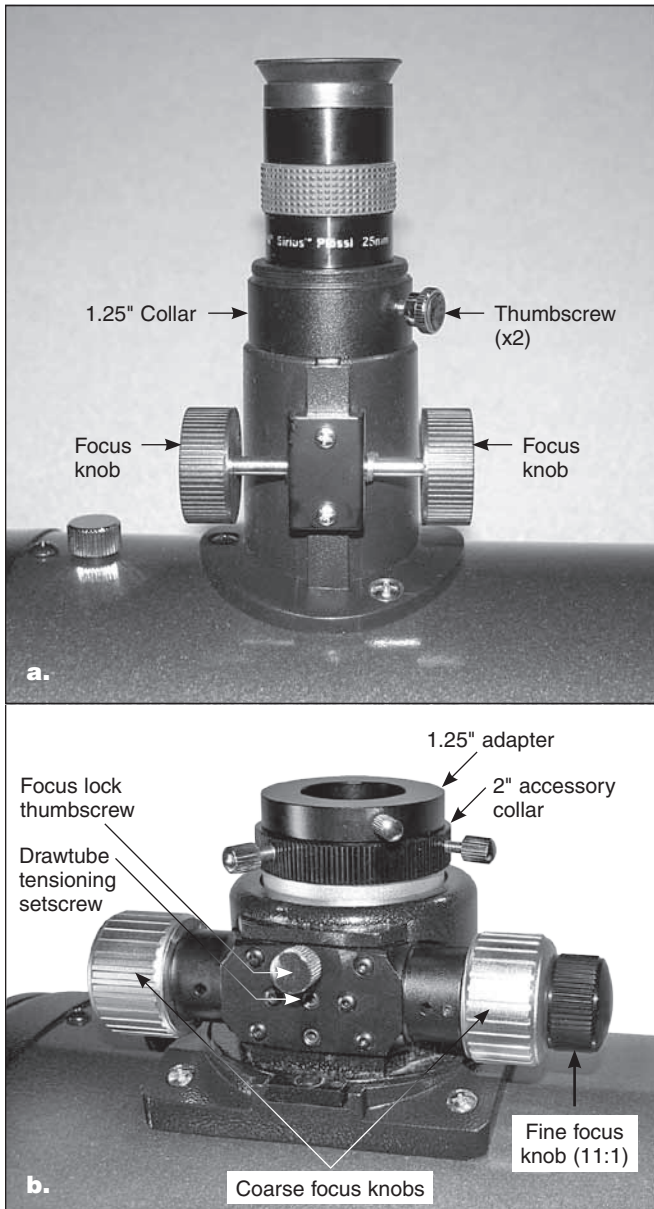
**Figure 13.** XT PLUS Dobsonians are “hands on” telescopes that have two directions of movement: altitude (up/down) and azimuth (left/right). Just grasp the front of the telescope and move it to the desired point in the sky.

## 3. Using Your Telescope

It is best to get a feel for the basic functions of the SkyQuest XT PLUS Dobsonian during the day, before observing astronomical objects at night. This way you will not have to fumble around trying to orient yourself in the dark! Find a spot outdoors where you have plenty of room to move around the telescope, and where you have a clear view of some object or vista that is at least 1/4-mile away. It is not critical that the base be exactly level, but it should be placed on somewhat flat ground or pavement to ensure smooth movement of the telescope.

### Moving the Telescope

The Dobsonian design permits easy manual movement of the telescope in the altitude (up / down) and azimuth (left / right) directions (**Figure 13**). The azimuth motion should be smooth, with fairly little resistance if the lock nut on the base's center



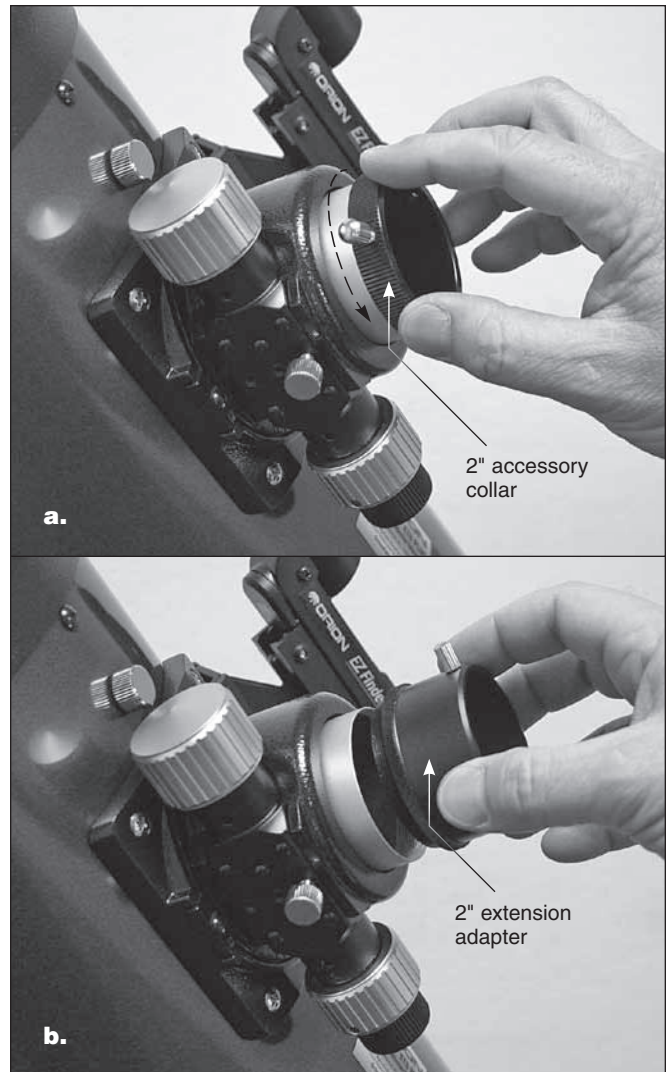
**Figure 14. (a)** The XT6 PLUS has a 1.25" rack-and-pinion focuser, **(b)** The XT8 and XT10 PLUS are equipped with a 2" dual speed Crayford focuser.

bolt is not over-tightened. For the altitude motion, the tension can be adjusted to the desired level with the altitude axis tensioning knob near the top of the left side panel.

To move the telescope, you simply grasp the front end of the tube and move the scope where you want it to point. If the tube drifts up or down when you let go of it, you will need to increase the friction by turning the altitude tensioning knob clockwise.

### Focusing

The focuser on the XT6 PLUS is a 1.25" rack-and-pinion type (Figure 14a), which accepts only 1.25" eyepieces. The XT8



**Figure 15. (a)** Removing the 2" accessory collar (XT8 PLUS only), **(b)** Thread the 2" extension adapter into the focuser drawtube.

and XT10 PLUS come standard with a 2" dual-speed Crayford-type gearless focuser (Figure 14b). The large 2" format focuser allows use of 2" or 1.25" eyepieces and the Crayford design prevents imaging shifting while focusing. The fine focus (11:1) knob on the Crayford focuser allows one to make very tiny focusing increments for ultra-precise focusing.

To focus, insert an eyepiece into the focuser and secure it with the thumbscrew(s). Now slowly rotate one of the coarse focus knobs until a distant 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're zeroing in on the exact focus point.

For the XT8 and XT10 PLUS, use the smaller, fine focus knob to achieve precise focus. Eleven turns of the fine focus knob is equivalent to one turn of the coarse focus knobs (11:1), so





**Figure 16.** The EZ Finder II superimposes a small red dot (it's not a laser!) on a non-magnified field of view, which helps to center an object in the telescope's field of view.

much finer adjustment is possible than with just the coarse focus knobs alone. You'll find this is a great convenience, especially when attempting to focus at high magnifications.

With either telescope, if you have trouble focusing, rotate the coarse focusing knob so the drawtube is inward as far as it will go. Now look through the eyepiece while slowly rotating the coarse focusing knob in the opposite direction. You should soon see the point at which focus is reached. The thumbscrew on the bottom of the focuser body (**Figure 14b**) will lock the focuser drawtube in place, if desired (XT8 and XT10 PLUS). This is usually not necessary, however. Before focusing, remember to first loosen this thumbscrew.

The following applies to the XT8 and XT10 PLUS focusers only:

If you find the drawtube tension when focusing is either too tight (i.e., focus knob is difficult to turn) or too loose (i.e., drawtube moves by itself under the weight of the eyepiece), you can adjust it by tightening or loosening the drawtube tensioning setscrew on the focuser, which is located just below the focus lock thumbscrew (see **Figure 14b**). Adjust this setscrew with the included 2.5mm hex key. Do not loosen the setscrew too much as there must be some tension to keep the drawtube secure within the focuser. The other setscrew below the drawtube tensioning setscrew does not affect drawtube tension and should not be adjusted.

If an image does not come into focus with a particular eyepiece because you run out of outward focus travel, you may need to use the included 2" extension adapter. This adapter threads onto the focuser drawtube. First, you'll need to remove the 2" accessory collar from the drawtube by unthreading it (**Figure 15a**). Then thread the 2" extension adapter into the drawtube (**Figure 15b**). Insert a 2" eyepiece into the extension adapter and secure it with the two thumbscrews. Or, to use 1.25" eyepiece with the extension adapter, insert the 1.25" adapter into the extension adapter, then insert the eyepiece into the 1.25" adapter.

## Using the EZ Finder II

The EZ Finder II works by projecting a tiny red dot (it's not a laser beam!) onto a 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 (**Figure 16**). The red dot is produced by a light-emitting diode (LED) near the rear of the unit.

Turn the power knob (see **Figure 11**) 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 quite dim. The intensity of the dot is adjusted by turning the power knob. For best results when stargazing, use the 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 in daylight.

At the end of your observing session, be sure to turn the power knob counterclockwise until it clicks 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 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  $\frac{1}{4}$  mile away. Now, with the EZ Finder II turned on, look through the EZ Finder II. The object should appear in the field of view.

Without moving the main telescope, use the EZ Finder II's azimuth (left/right) and altitude (up/down) adjustment knobs (see **Figure 11**) 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 not, re-center it and adjust the EZ Finder II's alignment again. When the object is centered in BOTH the eyepiece and the EZ Finder's red dot, the EZ Finder II is properly aligned with the telescope. Once aligned, the

EZ Finder II will usually hold its alignment even after being removed and remounted. Otherwise, only minimal realignment will be needed.

Now that the EZ Finder II is aligned, the telescope can be quickly and accurately pointed at anything you wish to observe. The EZ Finder II has a much wider field of view than the telescope's eyepiece, and therefore it is much easier to first center an object in the EZ Finder II. Then, if the EZ Finder II is accurately aligned, the object will also be centered in the telescope's field of view.



**Figure 17.** A proper way to carry the telescope, with tube assembly uncoupled from the base. (XT8 PLUS shown)

### Magnification

Magnification, or power, is determined by the focal length of the telescope and the focal length of the eyepiece. Magnification is calculated as follows:

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

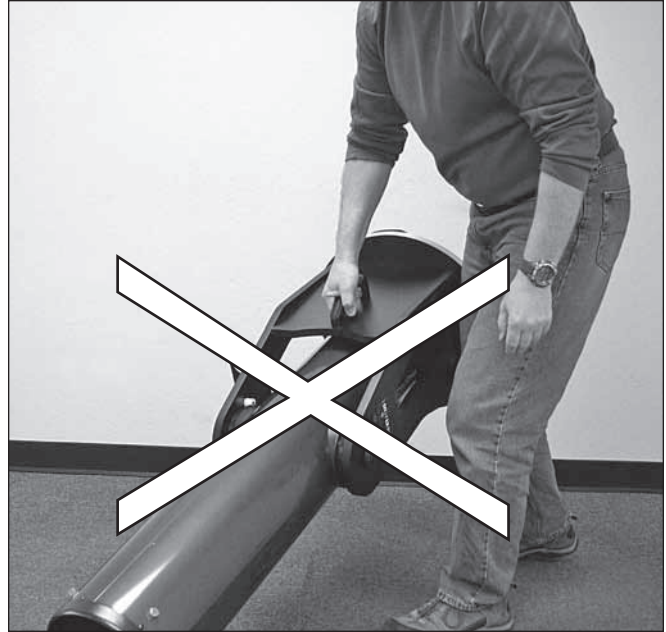
Magnification of the telescope can be changed by using different eyepieces. The XT8 PLUS has a focal length of 1200mm. So, the magnification with the supplied 10mm eyepiece is:

$$\frac{1200\text{mm}}{10\text{mm}} = 120\text{x}$$

By the same formula, when using the 28mm DeepView eyepiece the magnification would be 42.9x.

The maximum attainable magnification for a telescope is directly related to how much light its optics can collect. A telescope with more light-collecting area, or aperture, can yield higher magnifications than a smaller aperture telescope. The maximum practical magnification for any telescope, regardless of optical design, is about 60x per inch of aperture. This translates to about 480x for the XT8 PLUS.

Keep in mind that as magnification is increased, the brightness of the object being viewed will decrease; this is an inherent principle of the physics of optics 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!



**Figure 18.** Do not attempt to carry the fully assembled telescope by the handle on the base! The front of the optical tube could contact the ground and damage the tube, the focuser, and any attached accessories. (XT8 PLUS shown)

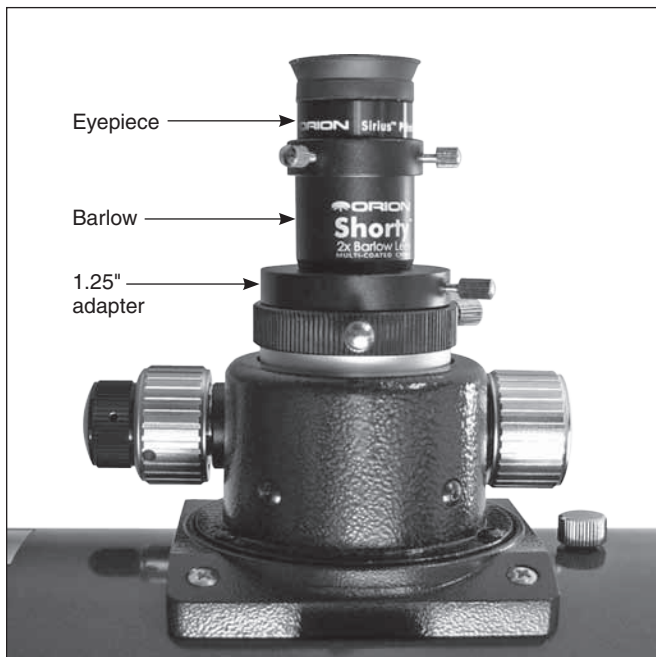
### Note About High Magnifications:

Maximum magnifications are achieved only under the most ideal viewing conditions at the best observing sites. Most of the time, magnifications are limited to 200x or less, regardless of aperture. This is because the Earth's atmosphere distorts light as it passes through. On nights of good "seeing," the atmosphere will be still and will yield the least amount of distortion. On nights of poor seeing, the atmosphere will be turbulent, which means different densities of air are rapidly mixing. This causes significant distortion of the incoming light, which prevents sharp views at high magnifications. The sharpest images will always be achieved at lower magnifications.

### Tube Balance

The SkyQuest XT PLUS tube is held on the Dobsonian base with two altitude axis coupling knobs (**Figure 10**). The one on the right side acts simply as a retaining knob, while the one on the left side is the "tensioning" knob. Turning this knob clockwise pulls the telescope's left side bearing into the left side panel, increasing the friction between the side bearing's fiber ring and the melamine surface of the side panel. The tighter the knob is turned, the greater the friction and the stiffer the tube will become to move up and down. Ideally you'll want to set the tension such that the tube moves relatively freely, so that you can "track" objects smoothly by moving it in small increments while viewing through the eyepiece.

If using heavier accessories on the front of the scope, increasing the tension on the altitude axis will prevent the front of the scope from sagging under the weight. That is, you can "adjust out" a modest scope imbalance by increasing the tension via the tensioning (left) knob.



**Figure 19.** The Shorty 2x Barlow is installed in the focuser's 1.25" adapter and accepts any 1.25" eyepiece, doubling its magnification.

### Carrying/Transporting the Telescope

Moving the SkyQuest XT PLUS is easy to do. We recommend detaching the telescope tube from the base and carrying the two pieces separately, as in **Figure 17**. *We DO NOT recommend carrying the entire telescope – with the tube still attached to the base – by the handle on the base's front panel!* If you do, the telescope tube could swing downward and contact the ground (**Figure 18**).

**CAUTION** – When removing the altitude axis coupling knobs, make sure that the black bushings do not fall out and get lost! Either remove them along with the knobs and keep them all together, or leave the bushings in the holes – but make sure they do not fall out.

When transporting the XT PLUS in a vehicle, be sure to isolate the optical tube assembly so that it cannot slide or roll, which could dent the tube. We recommend transporting and storing the tube assembly in a padded case for protection.

Finally, keep the dust cover on the front of the telescope when the telescope is not in use. Doing so will keep dust from accumulating on the primary mirror.

### Using the Shorty 2x Barlow Lens

The Shorty 2x Barlow included with your SkyQuest XT PLUS will double the magnification of any 1.25" eyepiece it is used with. It effectively increases the number of available magnification options at your disposal, depending on how many 1.25" eyepieces you have.

You just insert the Barlow into the 1.25" adapter and secure it with the thumbscrew. Then insert a 1.25" eyepiece into the Barlow and secure it with the thumbscrew on the Barlow



**Figure 20.** The included Safety Film Solar Filter snaps onto the front of the telescope for safe viewing of our Sun through the telescope eyepiece. **DO NOT** look through the EZ Finder II to center the Sun in the telescope's field of view!

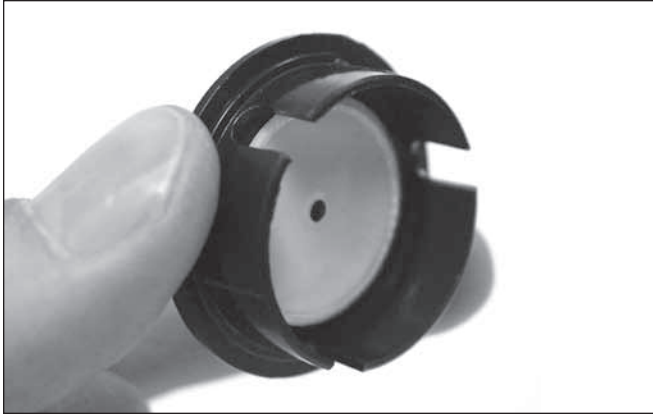
(**Figure 19**). Finally, adjust the focus as necessary using the telescope's focus wheels to achieve a sharp image.

### Using the Safety Film Solar Filter

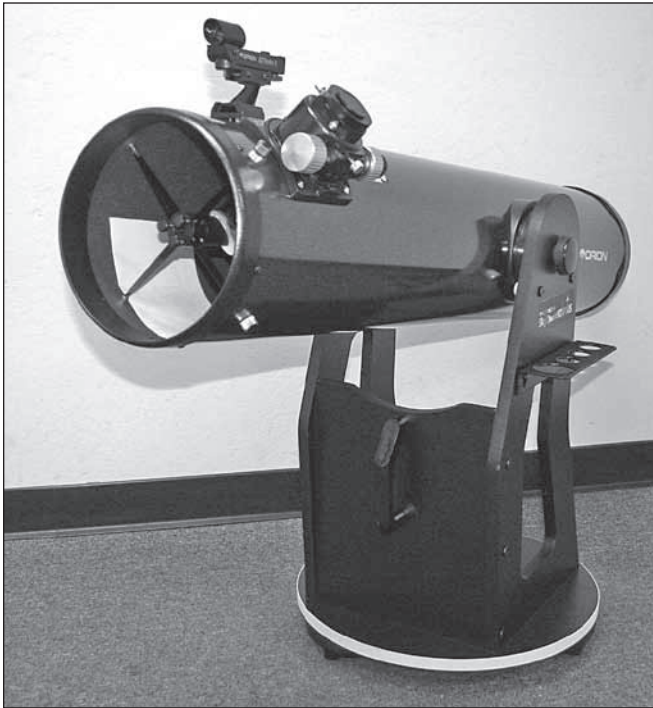
Also included with your XT PLUS is a Safety Film Solar Filter that permits daytime viewing of our nearest star, the Sun (**Figure 20**). The white-light filter uses high-quality Baader Astro Solar safety film, which reduces the transmission of the Sun's radiation to a safe level, allowing great views of sunspots, solar eclipses, and planetary transits of our Sun. Through the filter the Sun appears in its natural color – a neutral white color, without any orange or blue tinting seen with some other types of solar filter material. Don't worry if the material appears "wrinkled" or wavy; this is normal and does not adversely affect the image seen through the filter!

**DO NOT try to center the Sun's disk in the main telescope by viewing through the EZ Finder III!** Only a finder scope equipped with a proper solar filter, or a special solar aiming device, should be used. A good way to "find" the Sun in your telescope is to point the scope (with solar filter in place!) in the general direction of the Sun, then with a wide-field eyepiece in the focuser slowly sweep the area until you glimpse the Sun's disk in the eyepiece. It's best to focus the telescope on a distant object *before* attaching the solar filter, because with the solar filter in place you will not see anything except the Sun's disk – and if you're way out of focus you may not even see that!

DO keep the solar filter in its box when not in use to protect it from damage. **If you notice even the smallest tear or breach in the solar film material, DO NOT LOOK THROUGH THE TELESCOPE!** Permanent eye damage could result. Call Orion Customer Support for assistance.



**Figure 21.** The quick collimation cap, which features a reflective inner surface, helps in centering reflections of the optics in the focuser during the collimation process.



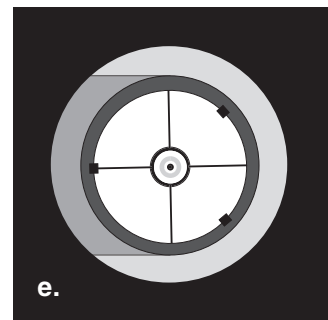
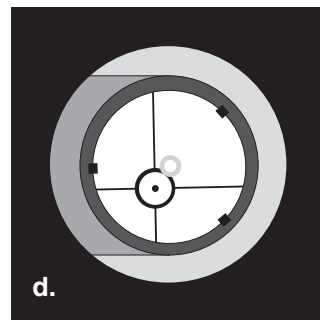
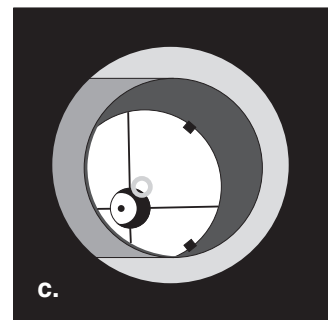
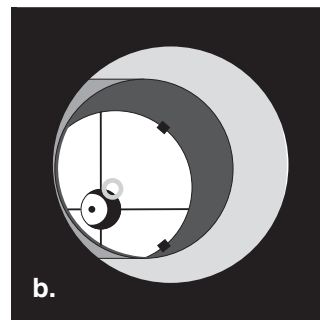
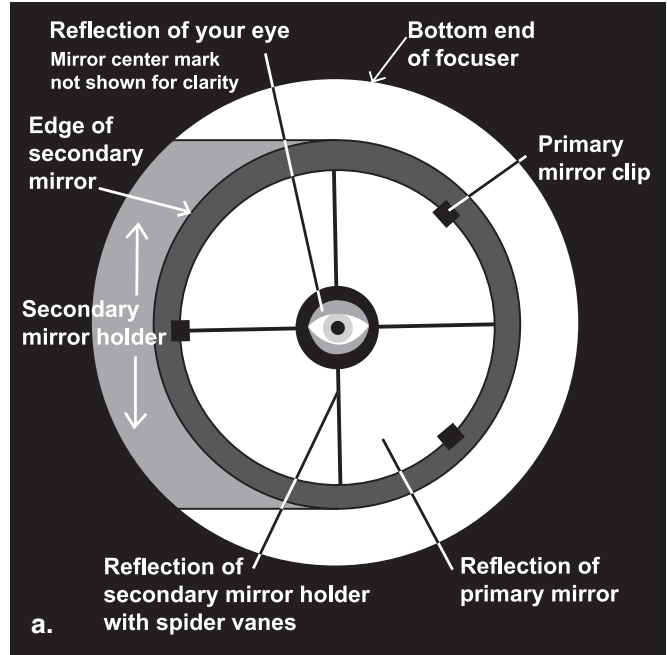
**Figure 22.** The telescope ready for collimation, with the tube oriented horizontally, the collimation cap in place on the focuser, and a piece of white paper placed inside the tube opposite the focuser.

## 4. Collimation

Collimation is the process of adjusting the mirrors so they are correctly aligned with one another. Your telescope's optics were aligned at the factory, but they could become misaligned during shipment. Accurate mirror alignment is important to ensure the peak performance of your telescope, so it should be checked regularly. Collimation is relatively easy to do and can be done in daylight.

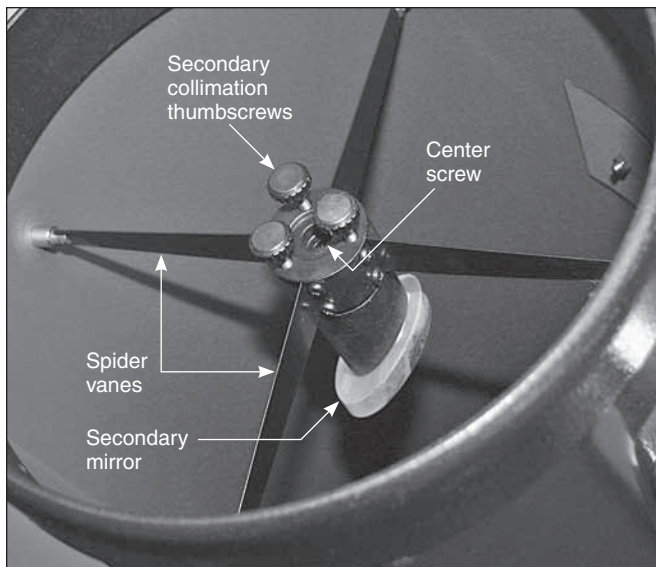
### The Collimation Cap and Mirror Center Mark

Your XT PLUS comes with a "quick-collimation" cap (Figure 21). This is a simple cap that fits on the focuser drawtube like a



**Figure 23.** Collimating the optics. **(a)** When the mirrors are properly aligned, the view down the focuser drawtube should look like this; **(b)** With the collimation cap in place, if the optics are out of alignment, the view might look something like this; **(c)** Here, the secondary mirror is centered under the focuser, but it needs to be adjusted (tilted) so that the entire primary mirror is visible; **(d)** The secondary mirror is correctly aligned, but the primary mirror still needs adjustment. When the primary mirror is correctly aligned, the "dot" will be centered, as in **(e)**.

dust cap, but has a hole in the center and a reflective material on the underside. The cap helps center your eye so that col-



**Figure 24.** The secondary mirror and “spider.” The XT PLUS features three thumbscrews for easy adjustment of the secondary mirror tilt.

limation is easy to perform. **Figures 23a** through **23e** assume you have the collimation cap in place.

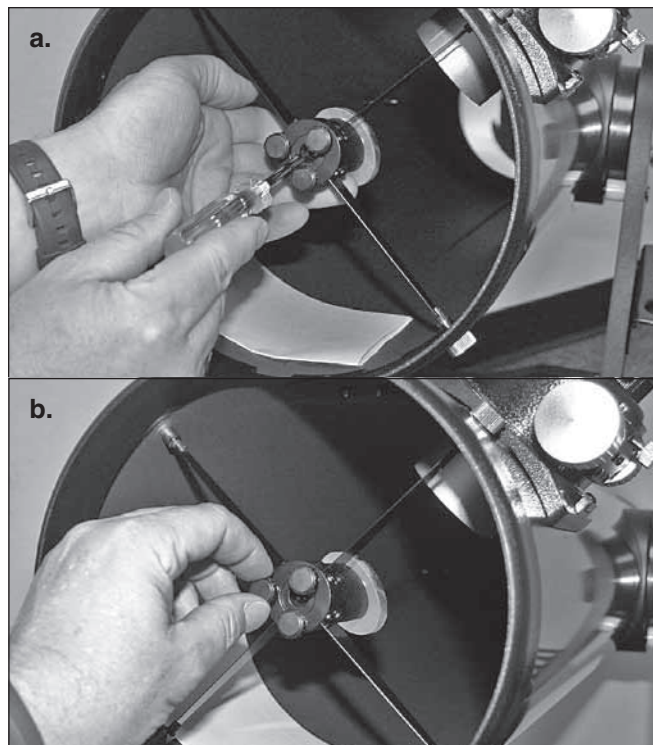
You will notice a tiny ring (sticker) in the exact center of the primary mirror. This “center mark” allows you to achieve a very precise collimation of the primary mirror; you don’t have to guess where the center of the mirror is. You simply adjust the mirror position (described below) until the reflection of the hole in the collimation cap is centered inside the ring. This center mark is also required for best results with other collimating devices, such as Orion’s LaserMate Deluxe Laser Collimator.

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

### Preparing the Scope for Collimation

Once you get the hang of collimation, you will be able to do it quickly even in the dark. When trying it for the first time or two, though, it is best to collimate in daylight, preferably in a brightly lit room and with the telescope aimed at a white wall. It is recommended that the telescope tube be oriented horizontally. This will prevent any parts from the secondary mirror from falling down onto the primary mirror and causing damage, should something come loose when you are making adjustments. Place a sheet of white paper inside the optical tube directly opposite the focuser. This will provide a bright “background” when viewing into the focuser. When properly set up for collimation, your telescope should resemble **Figure 22**.

To check the scope’s collimation, remove the eyepiece and look down the focuser drawtube. You should see the secondary mirror centered in the drawtube, as well as the reflection of the primary mirror centered in the secondary mirror, and the reflection of the secondary mirror (and your eye) centered in the reflection of the



**Figure 25. (a)** To center the secondary mirror under the focuser, hold the secondary mirror holder in place with one hand while adjusting the center bolt with a Phillips screwdriver. Do not touch the mirror’s surface! **(b)** Adjust the tilt of the secondary mirror by loosening or tightening the three alignment thumbscrews.

primary mirror, as in **Figure 23a**. If anything is off-center, as in **Figure 23b**, proceed with the following collimation procedure.

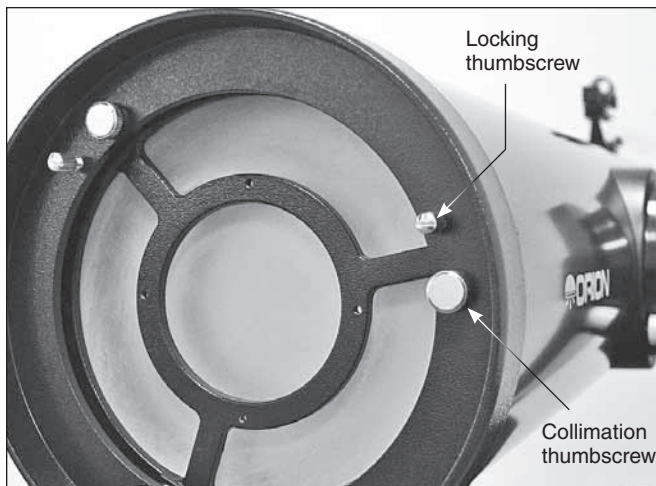
### Aligning the Secondary Mirror

With the collimation cap in place, look through the hole in the cap at the secondary (diagonal) mirror. Ignore the reflections for the time being. The secondary mirror itself should be centered in the focuser drawtube, in the direction parallel to the length of the telescope. If it is, **you can skip the next two paragraphs**. If it isn’t, as in **Figure 23b**, it must be adjusted. This adjustment will rarely, if ever, need to be done.

The secondary mirror is bonded to a holder held by four “spider” vanes (**Figure 24**). While holding the secondary mirror holder with one hand, being careful not to touch the surface of the mirror, loosen the three secondary mirror collimation thumbscrews a couple of turns each. Now, with a Phillips screwdriver, turn the center screw of the holder to move it forward or back (**Figure 25a**). Turning the screw clockwise will move the secondary mirror toward the front opening of the optical tube, while turning the screw counter-clockwise will move the secondary mirror toward the primary mirror.

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

When the secondary mirror is centered in the focuser drawtube, rotate the secondary mirror holder until the reflection of the primary mirror is as centered in the secondary mirror as



**Figure 26.** The tilt of the primary mirror is adjusted by turning one or more of the three larger thumbscrews. The three small thumbscrews lock the primary mirror in place and must be loosened before any adjustments can be made, then re-tightened (lightly) once the primary mirror has been adjusted.

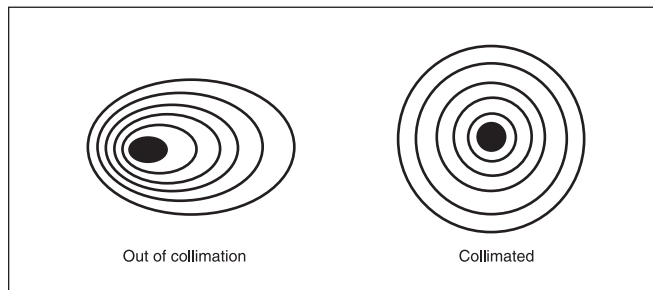
possible. It may not be perfectly centered, but that is OK. Now re-tighten the three secondary mirror collimation thumbscrews equally to secure the secondary mirror in that position.

If the entire primary mirror reflection is not visible in the secondary mirror, as in **Figure 23c**, you will need to adjust the tilt of the secondary mirror. This is done by alternately loosening one of the three alignment thumbscrews while lightly tightening the other two (**Figure 25b**). Do not make excessive turns of these thumbscrews or force them past their normal travel. A mere 1/4 turn of the screw can dramatically change the tilt of the mirror. The goal is to center the primary mirror reflection in the secondary mirror, as in **Figure 23d**. Don't worry that the reflection of the secondary mirror (the smallest circle, with the collimation cap "dot" in the center) is off-center. You will fix that in the next step.

#### Adjusting the Primary Mirror

The final adjustment is made to the primary mirror. It will need adjustment if, as in **Figure 23d**, the secondary mirror is centered under the focuser and the reflection of the primary mirror is centered in the secondary mirror, but the small reflection of the secondary mirror (with the "dot" of the collimation cap) is off-center.

The tilt of the primary mirror is adjusted with three spring-loaded collimation thumbscrews on the back end of the optical tube (bottom of the primary mirror cell); these are the larger thumbscrews (**Figure 26**). The three smaller thumbscrews



**Figure 27.** A star test will determine if a telescope's optics are properly collimated. An unfocused view of a bright star through the eyepiece should appear as illustrated on the right if the optics are perfectly collimated. If the circle is unsymmetrical, as in the illustration on the left, the scope needs collimation.

lock the mirror's position in place; these thumbscrews must be loosened before any collimation adjustments can be made to the primary mirror.

To start, turn the smaller thumbscrews a few turns each.

Now, try tightening or loosening one of the large collimation thumbscrews with your fingers. Look into the focuser and see if the secondary mirror reflection has moved closer to the center of the primary. You can tell this easily with the collimation cap and mirror center mark by simply watching to see if the "dot" of the collimation cap is moving closer or farther away from the ring on the center of the primary mirror. When you have the dot centered as much as possible in the ring, your primary mirror is collimated. The view through the collimation cap should resemble **Figure 23e**. Retighten the locking thumbscrews.

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

#### Star-Testing the Telescope

When it is dark, point the telescope at a bright star and accurately center it in the eyepiece's field of view. Slowly de-focus the image with the focusing knob. If the telescope is correctly collimated, the expanding disk should be a perfect circle (**Figure 27**). If the image is unsymmetrical, the scope is out of collimation. The dark shadow cast by the secondary mirror should appear in the very center of the out-of-focus circle, like the hole in a donut. If the "hole" appears off-center, the telescope is out of collimation.

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

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## 5. Specifications

### SkyQuest XT6 PLUS

Primary mirror focal length:	1200mm
Primary mirror diameter:	150mm
Minor axis of secondary mirror:	34mm
Optics:	Parabolic, diffraction limited
Mirror coatings:	Enhanced aluminum (94% reflectivity), with SiO <sub>2</sub> overcoat
Focal Ratio:	f/8.0
Focuser:	2" Crayford, dual-speed (11:1), accepts 2" eyepieces and 1.25" eyepieces with included adapter

Optical tube material:	Rolled steel
Eyepieces:	10mm Sirius Plössl, 1.25" barrel dia. 25mm Sirius Plössl, 1.25" barrel dia.

Magnification with supplied eyepieces:	120x (10mm Sirius) 48x (25mm Sirius)
Reflex sight:	EZ Finder II
Optical tube weight:	11.5 lbs.
Base weight:	21.9 lbs.
Tube length:	46"
Tube outer diameter:	7.28"
Cooling fan:	Optional, ready to mount

### SkyQuest XT8 PLUS

Primary mirror focal length:	1200mm
Primary mirror diameter:	203mm
Minor axis of secondary mirror:	47.0mm
Optics:	Parabolic, diffraction limited
Mirror coatings:	Enhanced aluminum (94% reflectivity), with SiO <sub>2</sub> overcoat
Focal Ratio:	f/5.9
Focuser:	2" Crayford, dual-speed (11:1), accepts 2" eyepieces and 1.25" eyepieces with included adapter

Optical tube material:	Rolled steel
Eyepieces:	10mm Sirius Plössl, 1.25" barrel dia. 28mm DeepView, 2" barrel dia.
Magnification with supplied eyepieces:	120x (10mm Sirius) 43x (28mm DeepView)
Reflex sight:	EZ Finder II
Optical tube weight:	20.3 lbs.
Base weight:	21.3 lbs.
Tube length:	46.5"
Tube outer diameter:	9.25"
Cooling fan:	Optional, ready to mount

### SkyQuest XT10 Plus

Primary mirror focal length:	1200mm
Primary mirror diameter:	254mm
Minor axis of secondary mirror:	63.0mm
Optics:	Parabolic, diffraction limited
Mirror coatings:	Enhanced aluminum (94% reflectivity), with SiO <sub>2</sub> overcoat
Focal Ratio:	f/4.7
Focuser:	2" Crayford, dual-speed (11:1), accepts 2" eyepieces and 1.25" eyepieces with included adapter

Optical tube material:	Rolled steel
Eyepieces:	10mm Sirius Plössl, 1.25" barrel dia. 28mm DeepView, 2" barrel dia.
Magnification with supplied eyepieces:	120x (10mm Sirius) 43x (28mm DeepView)
Reflex sight:	EZ Finder II
Optical tube weight:	28.7 lbs.
Base weight:	24.8 lbs.
Tube length:	47.4"
Tube outer diameter:	9.25"
Cooling fan:	Optional, ready to mount

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## **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.

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