

# Orion 8" and 10" f/3.9 Newtonian Astrographs

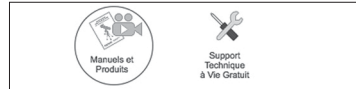
#8297 8" f/3.9, #8296 10" f/3.9

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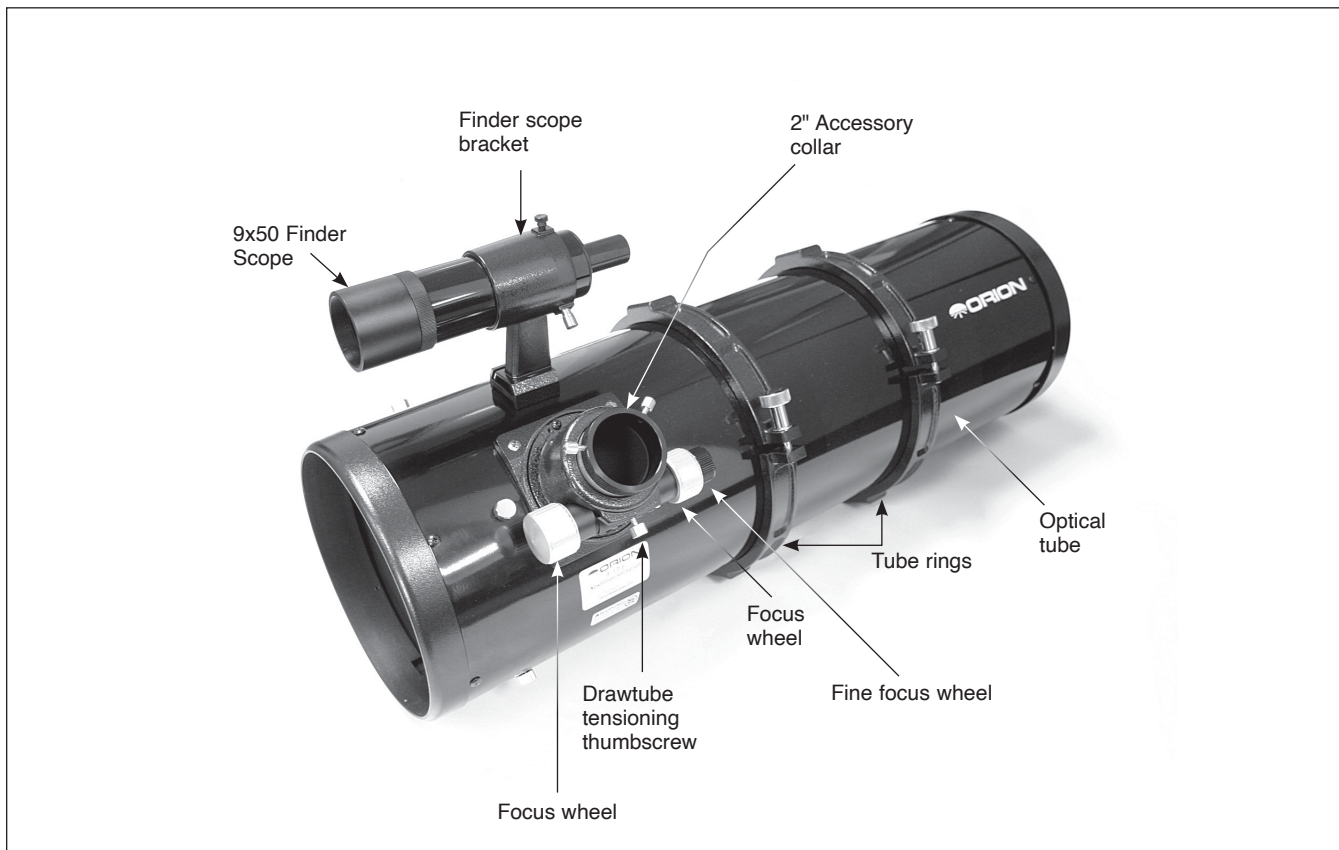


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**Figure 1.** The Orion 8" f/3.9 Newtonian Astrograph

*Congratulations on your purchase of an Orion f/3.9 Newtonian Astrograph!* These powerful imaging telescopes feature “fast,” high-quality parabolic optics, a 2" dual-speed Crayford focuser, and excellent mechanical construction with some special features. Optimized for astrophotography with DSLR and astronomical CCD imaging cameras, our f/3.9 Newtonian Astrographs are capable of delivering breathtaking imaging performance – for beginning to advanced astrophotographers.

This instruction manual covers both the 8" and 10" models of f/3.9 Newtonian astrograph. Although they differ in aperture and focal length, physical size, and weight, they are otherwise very similar in mechanical construction and features. So we will use the 8" model to illustrate the features of both astrographs. Any exceptions related to the 10" model will be noted.

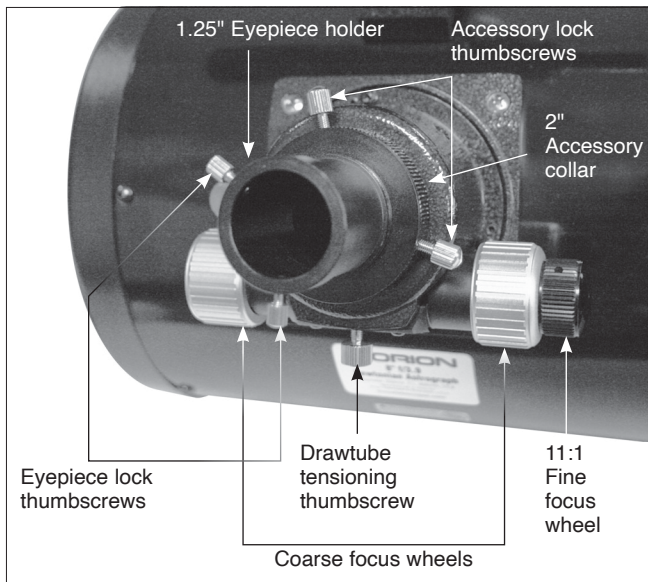
This instruction manual will help you to set up and properly use your telescope. Please read it through completely before attempting to use the scope and its included accessories.

**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.*

## Parts List

- Optical tube assembly
- Optical tube dust cap
- 1.25" eyepiece holder
- 9x50 finder scope with bracket
- Pair of hinged tube rings
- 2" thread-on extension adapter, 30mm
- 2" slip-on extension adapter, 36mm
- Quick collimation cap
- Cooling accelerator fan and battery holder (batteries not included)
- Starry Night Special Edition CD-ROM and StarTheater DVD

We recommend keeping all of the original packaging. In the unlikely event you should need to ship the telescope back to Orion for warranty repair service, you should use the original



**Figure 2.** The 2" dual-speed (11:1) Crayford focuser

packaging to ensure the telescope stays intact during shipping. Take a moment to inspect the telescope and all of its parts.

**Before proceeding with the instructions, refer to Figure 1 to familiarize yourself with some of the features and components of the telescope.**

## Getting Started

The telescope arrives nearly fully assembled from the factory, with optics installed, in a single shipping box. The optics were collimated at the factory, however you should check the collimation prior to first use (see “Collimating the Optics”), as it’s not uncommon for Newtonian optics to get bumped slightly out of collimation in the delivery process. Likely only a minor adjustment, if any, may be necessary.

### Attaching the Telescope to a Mount

The f/3.9 Newtonian Astrographs each come with a pair of hinged, felt-lined tube rings to hold the optical tube assembly (OTA) on a mount. Each ring has a flat boss on opposing sides. Both bosses have a ¼"-20 threaded hole in the center. One tube ring has a piggyback camera adapter mounted on one of the bosses, which can be used to mount a camera for piggyback astrophotography. That adapter can be removed if you wish to attach an optional dovetail plate to the top of the tube rings for mounting a piggybacked guide scope.

The tube rings should be attached to a dovetail mounting plate (sold separately) compatible with your mount’s equatorial head. Balancing the telescope is achieved by sliding the dovetail mounting plate forward or backward within the mount’s dovetail saddle. You can also move the telescope forward or backward within the tube rings. To do so, loosen the tube ring clamps slightly and slide the telescope tube forward or backward as needed to reach optimum balance,

then retighten the clamps. Rotating the telescope to achieve a comfortable eyepiece or camera angle is done in the same fashion. Simply loosen the tube ring clamps just enough to allow the optical tube to rotate within the tube rings. Retighten the tube ring clamps securely once you have reached the desired eyepiece or camera orientation.

### 2" Dual-Speed Crayford Focuser

The f/3.9 Newtonian Astrograph features an all-metal, 2" dual-speed (11:1) Crayford-type focuser (**Figure 2**), which allows very precise, fine focusing. A reinforcing plate inside the optical tube just under the focuser provides added rigidity, minimizing any “flexing” of the focuser housing on the tube due to the weight and moment arm of the imaging camera. If the drawtube slips under the weight of your imaging system or heavy visual accessories, simply increase the drawtube tension by gently tightening the drawtube tensioning thumbscrew as needed.

The smooth focus motion and fine-focus wheel allow precision adjustments for critical focusing of eyepieces and cameras. Once focus is reached, you can lock the drawtube in place by tightening the drawtube tensioning thumbscrew.

The focuser drawtube has a 2" collar on the end of it, with two thumbscrews, for attachment of 2" accessories. The telescope ships with a 1.25" eyepiece holder inserted into the 2" collar.

The focuser drawtube has 38mm of travel.

### Fine Focus

The dual-speed Crayford focuser features both coarse and fine focusing wheels. The two large, silver-colored wheels are for coarse focusing. The small black wheel next to the right-hand large focus wheel allows ultra-precise focus adjustment at a gear ratio of 11:1, meaning eleven turns of the fine focus wheel equals one turn of the large focus wheel.

Use the large focus wheels to achieve rough focus on your target object, then use the fine focus wheel to home in on the exact focus point. You will be amazed at the amount of detail that careful fine focus adjustment brings in to view on targets such as the lunar surface, planets, double stars, and other celestial objects.

### Focuser Reinforcing Plate

You’ll notice that on the inside of the optical tube directly under the focuser is a steel reinforcing plate. This plate was added to provide extra rigidity to the interface between the focuser and tube, to minimize the possibility of flexure at that interface due to the weight of the imaging camera and its positional moment arm. Such flexure could cause undesirable distortion in long-exposure astrophotographic images. This reinforcing plate allows use of heavier cameras while minimizing the risk of flexure between the focuser base and tube. It is a design enhancement that other, similar scopes on the market do not have.

### Attaching the Finder Scope

The included 9x50 crosshair finder scope (**Figure 3a**) is useful for locating objects in the sky and centering them in the main telescope's field of view.

To install it, first remove the O-ring from the bracket and place it over the body of the finder scope until it seats in the narrow groove near the middle of the finder. Unthread the two black nylon alignment screws on the bracket until the screw ends are flush with the inside surface of the bracket. Slide the eyepiece end (narrow end) of the finder scope into the end of the bracket's cylinder opposite the alignment screws while pulling the chrome, spring-loaded tensioning pin on the bracket with your fingers (**Figure 3b**). Push the finder scope through the bracket until the O-ring seats just inside the front opening. Release the tensioner and tighten the two black nylon screws a couple of turns each to secure the finder scope in place. The tips of the tensioner and nylon screws should seat into the wide groove on the finder scope's body.

Now slide the foot of the finder scope bracket into the dovetail base on the main telescope. You'll first have to back out the thumbscrew lock on the dovetail base a few turns to allow the bracket to slide in. Once the bracket is inserted, tighten the thumbscrew lock.

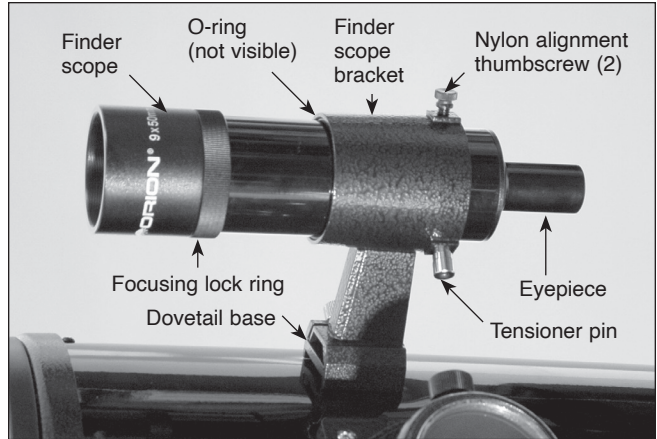
### Aligning the Finder Scope

The finder scope and the main telescope must be aligned so they point to exactly the same spot in the sky. Alignment is easiest to do in daylight. First, insert an eyepiece (a crosshair eyepiece is best) into the eyepiece holder in the telescope's focuser. Point the telescope at an 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? If not, hopefully it will be visible somewhere in the field of view, so that only a minor adjustment of the finder scope's two alignment screws will be needed to center it. Otherwise you'll have to make coarser adjustments to redirect the aim of the finder scope.

Once the target object is centered on the crosshairs of the finder scope, look again in the 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 telescope while adjusting the alignment of the finder scope. When the target object is centered on the crosshairs of the finder scope and in the telescope's eyepiece, the finder scope is aligned and ready to be used for locating objects.

The finder scope alignment should be checked before every imaging or observing session. This can easily be done at night, before viewing through the telescope. Choose any bright star or planet, center the object in the telescope eyepiece, and then adjust the bracket's alignment screws until the star or planet is also centered on the finder's crosshairs.



**Figure 3a.** The 9x50 finder scope and bracket



**Figure 3b.** Pull back the spring tensioning pin and slide the finder scope into its bracket until the O-ring is seated in the bracket ring.

### Focusing the Finder Scope

If the image in the finder scope appears out of focus, you will need to refocus the finder scope for your vision. First, loosen the lock ring located behind the objective lens cell on the body of the finder scope (**Figure 3a**). Back the lock ring off by a few turns. Then refocus the finder scope on a distant object by rotating the objective lens cell clockwise or counterclockwise. 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.

## Operating Your Orion f/3.9 Newtonian Astrograph

Your Orion f/3.9 Newtonian Astrograph is designed primarily for astro-imaging, but it makes a fine visual instrument as well. For visual use, we recommend using high-quality eyepieces to take full advantage of the instrument's exceptional optical quality. For imaging applications, the telescope is optimized for use with an APS-C or smaller size sensor, found in such cameras as the Orion StarShoot™ Pro, Orion Parsec™, and many DSLRs.

## 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 cool to the temperature outdoors. In very cold climates (below freezing), it is essential to store the telescope as cold as possible. If it has to adjust to more than a 40°F temperature change, allow at least one hour. You can use the telescope while it’s cooling down, just note that you may see “tube currents,” which interfere with the telescope’s ability to resolve a sharp image. Tube currents are essentially heat waves exiting both the optical components (such as the primary mirror) and the telescope itself. The effect seen through the eyepiece is much like looking above a hot surface or fire.

## Mirror Cooling Fan

Your f/3.9 Newtonian Astrograph comes with a cooling fan that attaches to the rear of the primary mirror cell. Using the fan reduces the amount of time required for the primary mirror to reach thermal equilibrium with the ambient air. The fan is powered by 12-volts DC. The included battery holder holds eight D-cell alkaline batteries (not included). Alternatively, the fan can be powered by a 12-volt DC field battery, such as the Orion Dynamo Pro.

## Fan Installation

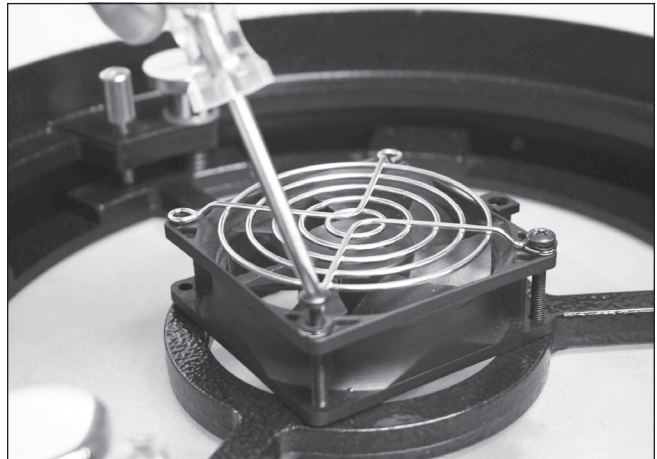
1. Place the fan on the rear of the mirror cell of the telescope and line up the holes in the fan with the threaded holes in the mirror cell. Make certain the label on the fan is facing the primary mirror.
2. Place the fan cover (wire grille) over the fan so the holes in its corners line up with the holes in the fan and mirror cell (**Figure 4a**). The fan cover should be oriented so that its corners seat flush onto the fan.
3. Thread a screw, with a washer attached, through the fan cover and fan and into the mirror cell (**Figure 4b**). Firmly tighten the screw, but be careful not to overtighten and strip the threads. Repeat this for the other three screws (and washers).
4. Insert eight D-cell batteries (not included) into the battery pack. Orient the batteries as shown on the plastic battery holder.
5. Plug the cord from the battery pack into the fan. The fan should begin rotating. If it doesn’t, check the connections and orientation of the batteries and try again. To turn the fan off, unplug the cord from the fan.

## Using the Cooling Fan

The cooling fan should be turned on as soon as the telescope is brought outdoors prior to your imaging or observing session. It should run for approximately 15-30 minutes to properly cool down the telescope. When the telescope is in use, the fan should be turned off. This is because even though it runs free from vibration, the air currents it generates in the optical tube will degrade image quality. Once the mirror has cooled to the outdoor ambient temperature, the fan will likely not be needed again for that session.



**Figure 4a.** Line-up the holes in the fan and fan cover with the holes in the rear of the primary mirror cell.



**Figure 4b.** Attaching the fan to the mirror cell.

## Imaging with the f/3.9 Newtonian Astrograph

This instrument has fast f/3.9 parabolic optics, which produce bright images and allow short exposure times. Fast optics also inherently produce some coma, or distortion of star images toward the periphery of the field of view. Therefore, to achieve the best possible images, we highly recommend use of a coma corrector (sold separately) designed for use with f/4 Newtonians, or for a range of focal ratios that includes f/4.

Many common coma correctors have a 2" diameter housing and T-threads for attachment to a camera. Typically, the coma corrector is attached to the front of the camera body via its T-threads (for DSLRs, to a compatible T-ring), then inserted into the 2" accessory collar of the focuser drawtube. Use of a coma corrector will allow you to utilize the entire imaging area of your camera without the need to crop the edges of your astro-images due to optical distortion. Check Orion’s website for compatible coma correctors.

## Attaching a CCD Camera

The Orion f/3.9 Newtonian Astrographs are equipped to accept CCD cameras with a 2" nosepiece, or a 2" coma cor-

rector in place of the nosepiece, which slides directly into the telescope's focuser like an eyepiece (**Figure 5**). The 2" nosepiece is secured with the two thumbscrew locks. If your CCD imager does not include a compatible 2" nosepiece, or if you wish to utilize the camera's T-threads without a coma corrector, a zero-profile prime focus camera adapter is required (available from Orion). The zero-profile adapter has male T-threads that couple to the female T-threads of your camera.

Note that, depending on your CCD camera's specifications, you may need to add T-thread spacer rings between the coma corrector and the CCD camera, to achieve the necessary critical distance between the coma corrector's rear lens element and the camera's imaging sensor.

### Attaching a DSLR Camera

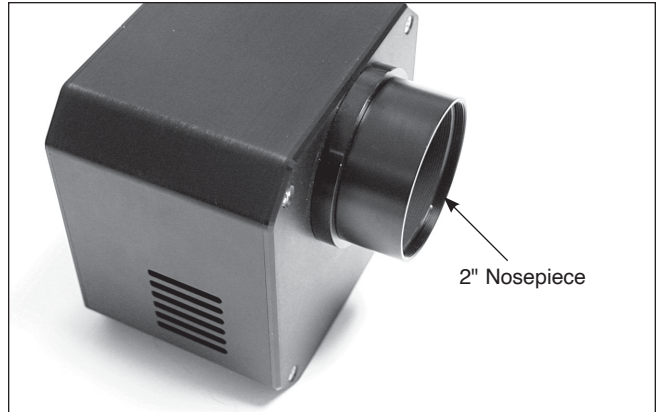
To attach a DSLR camera, you will need the appropriate T-ring for the make and model of your camera. If you do not plan to use a coma corrector, then you will need a zero-profile prime focus camera adapter (available from Orion). Simply attach the T-ring to the camera body and thread the zero-profile camera adapter into the T-ring. Then insert the barrel of the camera adapter into the focuser's 2" accessory collar and secure it with the two thumbscrew locks (**Figure 6**).

To use a coma corrector, thread it into the T-ring attached to your DSLR camera body, then insert the coma corrector housing into the focuser through the 2" accessory collar and tighten the two locking thumbscrews on the collar to secure the camera in place.

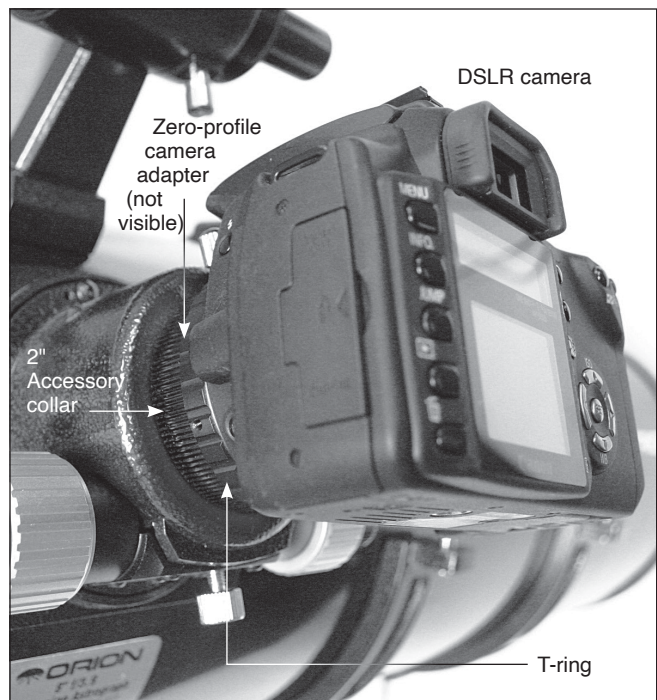
### Removing the Piggyback Camera Adapter from the Tube Ring

If you want to install an optional mounting plate atop the tube rings for piggyback attachment of a guide scope, you'll need to remove the piggyback camera adapter first. To do so, first remove the tube ring from the telescope. Then unthread the plastic ring from the threaded bolt. Peel back the felt lining on the inside surface of the tube ring where the bolt is located; peel it back just enough so that you can access the bolt head with a screwdriver. Using a Phillips screwdriver, remove the bolt from the ring. Now, replace the adhesive felt over the area where the bolt head was. Now the rings are ready to accommodate a mounting plate for your piggyback guide scope assembly.

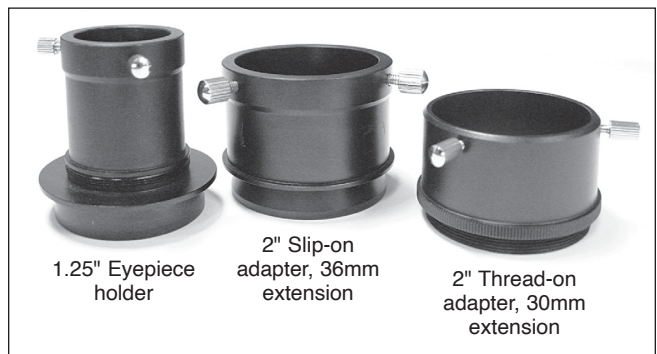
The Orion f/3.9 Newtonian Astrographs were designed with a couple of special enhancements to maximize the contrast of your astrophotographs and visual images. One is the inclusion of multiple baffle rings on the interior of the optical tube. The 8" model has 9 baffle rings and the 10" model has 13. These baffle rings block the transmission of off-axis light through the optical tube, which could reduce image contrast. The other contrast-enhancing feature is the extended length of the optical tube in front of the focuser. Both the 8" and 10" models have added length in front of the focuser, compared



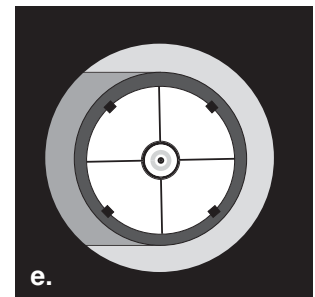
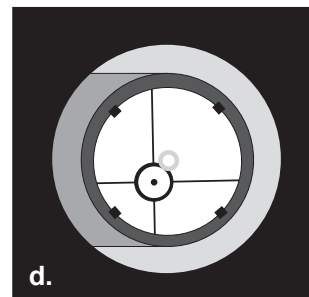
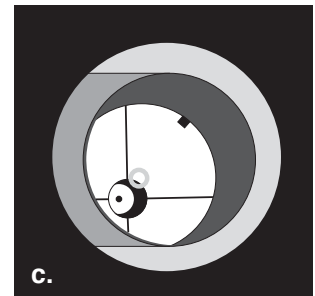
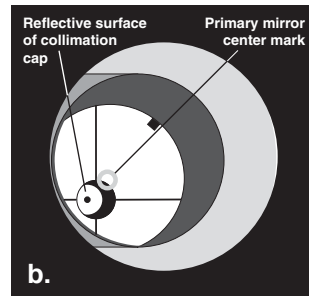
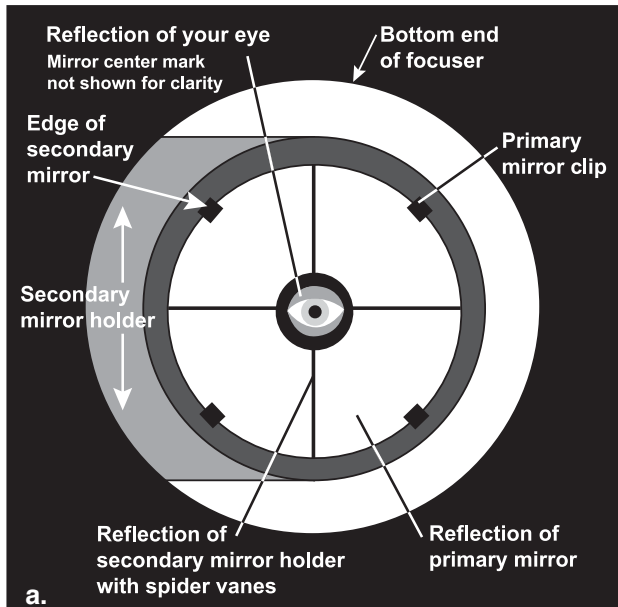
**Figure 5.** The Orion Parsec 8300 CCD camera, with 2" zero-profile adapter (nosepiece), which is included with the camera.



**Figure 6.** Attachment of a DSLR camera requires a T-ring for the particular camera model and a T-adapter, such as the Orion Zero-Profile Prime Focus Camera Adapter, which fits into the 2" accessory collar.



**Figure 7.** The 1.25" eyepiece holder and two 2" extension adapters included with the 8" and 10" f/3.9 Newtonian Astrographs.



**Figure 8.** 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 center “dot” of the collimation cap will be centered, as in (e).

to a standard Newtonian, to prevent any possibility of incoming light from impinging directly on the secondary mirror or entering the focuser drawtube. The baffle rings and the interior of the optical tube are both painted flat black to further absorb stray light. These enhancements ensure the best possible contrast when observing and photographing faint celestial objects.

### Visual Observing with the f/3.9 Newtonian Astrograph

The 8" and 10" f/3.9 Newtonian Astrographs are optimized for photographic imaging, but they can also be used of visual observing of celestial objects. (Because the field of view in a Newtonian reflector is rotated from right-side-up, this type of telescope is not recommended for terrestrial observing.) The tall 1.25" eyepiece holder adapter that comes installed in the focuser from the factory should allow you to achieve focus with most 1.25" telescope eyepieces (Figure 7).

For 2" eyepieces, you will likely have to use a 2" extension adapter to achieve focus with a 2" eyepiece. Two such adapters are included with your telescope (Figure 7). One is a thread-on adapter that adds 30mm of extension, the other is a slip-in adapter that adds 36mm of extension. You may need one or the other adapter depending on the amount of extension required for your eyepiece.

To install the thread-on 2" extension, first remove the 2" accessory collar on the focuser drawtube by turning it counterclockwise until it comes off. Then thread the 2" extension

adapter onto the focuser drawtube until tight. Insert a 2" eyepiece into the extension adapter and secure with the two thumbscrews. To install the slip-in 2" extension adapter, just insert its tapered base into the 2" accessory collar of the focuser, then tighten the two locking thumbscrews to secure the adapter in place.

### Collimating the Optics (Aligning the Mirrors)

Collimating is the process of adjusting the mirrors so they are aligned with one another. Precise collimation of the optics is especially critical for fast Newtonian optics such as in the f/3.9 astrographs. If the mirrors are even slightly misaligned, image quality will suffer. So you should check the collimation before every observing or imaging session, to make sure it is dead-on. The process of collimation is a relatively easy and can be done in daylight or darkness.

Your telescope's optics were collimated at the factory, and should not need much adjustment unless the telescope was handled roughly in transit. To check collimation, remove the eyepiece and look down the focuser drawtube. You should see the secondary mirror centered in the drawtube, as well as the reflection of the primary mirror centered in the secondary mirror, and the reflection of the secondary mirror (and your eye) centered in the reflection of the primary mirror, as in Figure 8a. If anything is off-center, proceed with the following collimating procedure.

## The Collimation Cap

Your f/3.9 Newtonian Astrograph comes with a “quick collimation cap” (Figure 9). This is a simple cap that fits on the focuser drawtube like a dust cap, but has a tiny hole in the center and a reflective inner surface. The collimation cap helps center your eye over the focuser drawtube so that aligning the optical components is easier to achieve. The reflective surface provides a distinct visual reference that is helpful in centering the primary and secondary mirror reflections. Figures 8b through 8e assume that you have the collimation cap in place.

We strongly recommend the use of a laser collimating tool such as the Orion LaserMate Deluxe or LaserMate Pro to aid in collimating the optics. A laser collimator will ensure a more precise collimation than you can usually achieve with the included collimation cap. With fast optics like those of the f/3.9 Newtonian Astrographs, getting a very precise collimation is critical for obtaining the sharpest, crispest images, so a laser collimator is a worthwhile (and small) investment. However, for the purposes of this instruction, we’ll assume that you don’t (yet) have a laser collimator, and that you’ll be using the supplied collimation cap.

## The Primary Mirror Center Mark

You’ll notice that the primary mirror of your f/3.9 Newtonian Astrograph has a tiny ring (sticker) marking its center. This “center mark” allows you to achieve a very precise collimation of the primary mirror; you don’t have to guess where the exact center of the mirror is.

**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 counter-intuitive, but it’s true!**

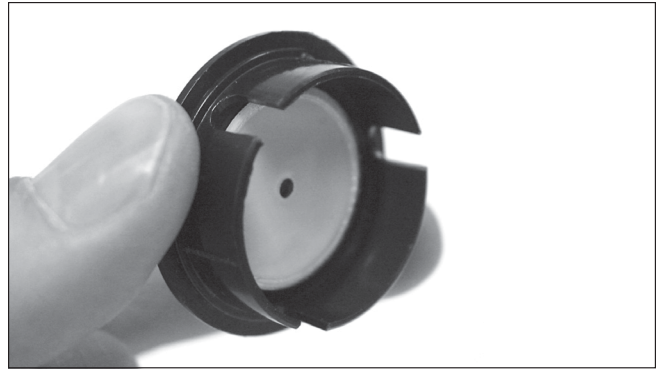
## Preparing the Telescope for Collimation

Once you get the hang of collimating, you will be able to do it quickly even in the dark. If you’re new to it, it is best to collimate in daylight, preferably in a brightly lit room and with the scope aimed at a light-colored 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 if something comes loose while you are making adjustments. Place a sheet of white paper inside the optical tube directly opposite the focuser (Figure 10). The paper will provide a bright “background” when viewing into the focuser during collimation.

## Aligning the Secondary Mirror

To adjust the secondary mirror collimation, you will need both a small and a large Phillips screwdriver.

You will need to check, and adjust if necessary, four aspects of the secondary mirror’s alignment:



**Figure 9.** The quick collimation cap, which features an inner reflective surface, helps in centering reflections of the optics in the focuser during the collimation process.



**Figure 10.** Placing a piece of white paper inside the optical tube opposite the focuser provides a bright background when viewing into the focuser.

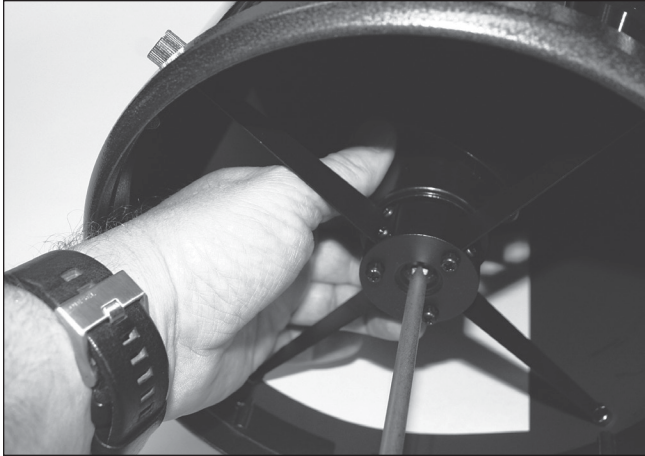
1. The secondary mirror’s axial position
2. The secondary mirror’s radial position
3. The secondary mirror’s rotational position
4. The secondary mirror’s tilt

The first three will probably only need to be checked and (possibly) adjusted once. Chances are, however, that they are set correctly from the factory and will not need any adjusting. *We recommend that you do not make the adjustments in 1 to 3 above unless you first determine that they absolutely need it!* It is usually only the secondary mirror’s tilt that will need to be adjusted occasionally.

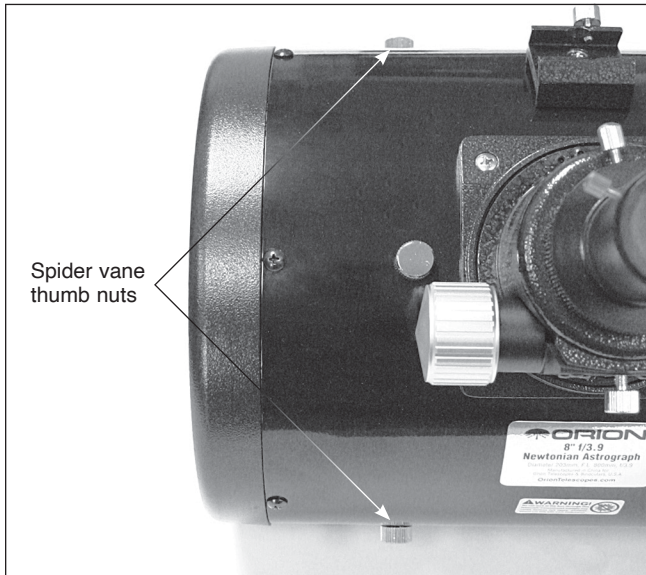
## Adjusting the Secondary Mirror’s Axial Position

With the collimating cap in place, look through the hole in the cap at the secondary (diagonal) mirror. Ignore the reflections





**Figure 11.** To center the secondary mirror axially under the focuser, hold the secondary mirror holder in place with your fingers while adjusting the center screw with a large Phillips-head screwdriver. Later you will adjust the tilt of the secondary mirror by turning the three small set screws that surround the large center screw.



**Figure 12.** To center the secondary mirror radially in the focuser drawtube, make adjustments to the two knurled spider vane thumbscrews that are perpendicular to the focuser.

for the time being. The secondary mirror itself should be centered in the focuser drawtube. If it is off-center along the axis of the telescope, i.e., positioned too far toward the front opening or toward the rear of the telescope, as it is in **Figure 8b**, you will have to adjust the mirror's axial position.

To do so, use a small Phillips screwdriver to loosen the three small alignment set screws in the center hub of the 4-vane spider several turns. Now, grasp the mirror holder (the cylinder that is attached to the back of the secondary mirror itself)

with one hand while turning the center screw with a large Phillips head screwdriver with your other hand (**Figure 11**). Turning the screw clockwise will move the secondary mirror toward the front opening of the optical tube, while turning the screw counter-clockwise will move the secondary mirror toward the primary mirror. When the secondary mirror is centered axially in the focuser drawtube, rotate the secondary mirror holder until the reflection of the primary mirror is as centered in the secondary mirror as possible. It may not be perfectly centered, but that is fine for now. Then, tighten the three small alignment set screws equally to secure the secondary mirror in that position.

### Adjusting the Secondary Mirror's Radial Position

Like the axial position, the secondary mirror's radial position was set at the factory and will probably not need any adjusting, or if it does, you'll typically need to do it only once.

By "radial position" we mean the position of the secondary mirror along the axis perpendicular to the focuser drawtube, as shown in **Figure 12**. This position is changed by adjusting two of the spider vane thumb nuts, as shown. Loosen one thumb nut, then tighten the opposite one until the secondary mirror is centered radially in the drawtube. Do not loosen the thumb nuts too much, to avoid having them completely unthread from the ends of the spider vanes. Also, when making this adjustment, be careful not to stress the spider vanes or they could bend.

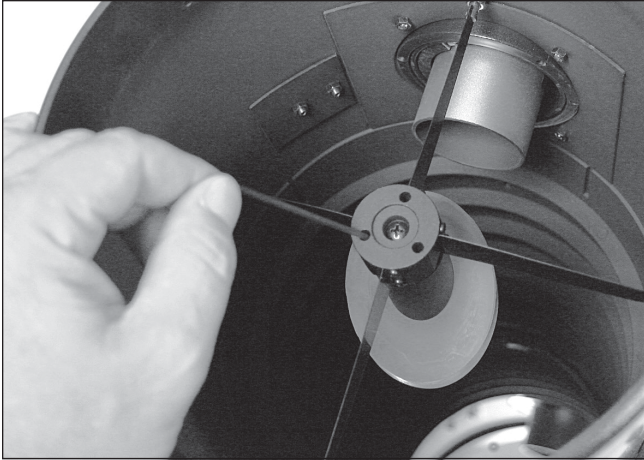
### Adjusting the Secondary Mirror's Rotational Position

The secondary mirror should face the focuser squarely. If the mirror appears to be rotated away from the focuser, the mirror's rotational position will need to be adjusted. Again, this adjustment will rarely, if ever, need to be done.

Grip the sides of the secondary mirror holder with your fingers. Then, using a large Phillips screwdriver, loosen the center screw in the secondary mirror holder about a quarter of a turn only (counterclockwise). That should be enough to free up the secondary mirror to rotate slightly in either direction. Look into the collimation cap and rotate the mirror slightly in each direction to get an idea of how it affects the view of the secondary mirror. Now rotate the mirror as needed so that it precisely faces the focuser. Hold the mirror holder stationary in that position while turning the center screw clockwise until it is just tight (do not over-tighten). Sometimes the mirror may rotate slightly when tightening the screw, so keep at it until the mirror faces the focuser squarely and is secured in place.

### Adjusting the Secondary Mirror's Tilt

Finally, the tilt of the secondary mirror may occasionally require adjustment. If the entire primary mirror reflection is not visible in the secondary mirror when using the collimation cap, as in **Figure 8c**, you will need to adjust the tilt of the secondary mirror. Using a 2mm Allen wrench, first loosen



**Figure 13.** The tilt of the secondary mirror is adjusted with a 2mm Allen wrench on the three setscrews surrounding the center Phillips-head bolt.

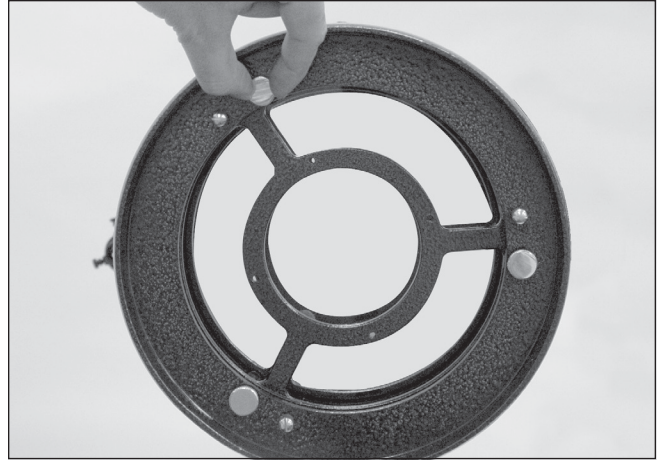
one of the three alignment set screws by, say, one full turn, and then tighten the other two to take up the slack (**Figure 13**). Do not loosen the center screw during this process. The goal is to center the primary mirror reflection in the secondary mirror, as in **Figure 8d**. When it is centered, you're done adjusting the secondary mirror. Don't worry that the reflection of the secondary mirror (the dark circle with the four spider vanes adjoining it) is off-center, since that adjustment is made when aligning the primary mirror in the next step.

### Aligning the Primary Mirror

The final collimation adjustment is made to the primary mirror. It will need adjustment if, as in **Figure 8d**, the secondary mirror is centered under the focuser and the reflection of the primary mirror is centered in the secondary mirror, but the reflection of the secondary mirror (dark circle containing the light reflective surface and center black "dot" of the collimation cap) is off-center.

The tilt of the primary mirror is adjusted with three spring-loaded collimation knobs on the back end of the optical tube (bottom of the primary mirror cell); these are the larger knobs (**Figure 14**). The other three smaller thumbscrews lock the mirror's position in place; these thumbscrews must be loosened before any collimation adjustments can be made to the primary mirror.

To adjust the primary mirror's tilt, first loosen all three locking (thin) thumbscrews by turning them counterclockwise a couple of turns each. Now, while looking into the focuser through the collimation cap, turn one of the larger collimation knobs a half turn or so in either direction and see if the secondary mirror reflection moves closer to the center of the primary. That is, does the "dot" of the collimation cap appear to move closer to the ring on the center of the primary mirror? If it does, great, keep going until you get it as close as you can. If it doesn't, try turning the collimation knob in the opposite direction. If turning the one knob does not seem to bring the dot closer to the ring, try using one of the other



**Figure 14.** The tilt of the primary mirror is adjusted by turning one or more of the three large, spring-loaded collimation knobs. The three thinner thumbscrews lock the primary mirror in place.

collimation knobs. It will take some trial-and-error using all three collimation knobs to properly align the primary mirror. Over time you will get the feel for which collimation knobs to turn to move the image in a given direction.

When you have the dot centered as much as possible in the ring, your primary mirror is collimated. Now lightly tighten the three locking thumbscrews to secure the primary mirror in place.

The view through the collimation cap should now resemble **Figure 8e**. A simple star test will indicate how well the telescope optics are collimated.

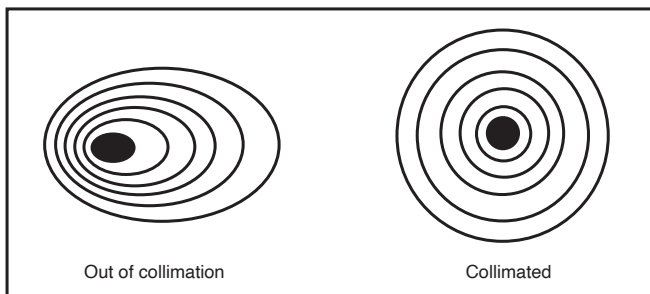
### Star-Testing the Telescope

When it is dark, point the telescope at a bright star and accurately center it in the eyepiece's field of view. (To achieve focus with an eyepiece, you will likely have to use the included 35mm extension adapter, as described previously.) Slowly de-focus the image with the focusing knob. If the telescope is correctly collimated, the expanding disk should be a perfect circle (**Figure 15**). If the image is unsymmetrical, the scope is out of collimation. The dark shadow cast by the secondary mirror should appear in the very center of the out-of-focus circle, like the hole in a donut. If the "hole" appears off-center, the telescope is out of collimation.

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

## Care & Maintenance

Give your telescope reasonable care and it will last a lifetime. When not in use, keep its dust cover on as well as



**Figure 15.** A star test will determine if the telescope's optics are properly collimated. A defocused 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 illustrated on the left, the optics need alignment.

the dust cap on the eyepiece opening. Keep the telescope inside the hard storage carrying case when not in use. Store it indoors or in a dry garage. Do not leave the telescope outside except when using it. The optical tube is aluminum and has a smooth anodized surface that should resist scratches and smudges. If a scratch does appear on the tube, it will not harm the telescope. Smudges on the tube can be wiped off with standard household cleaners such as Windex or Formula 409.

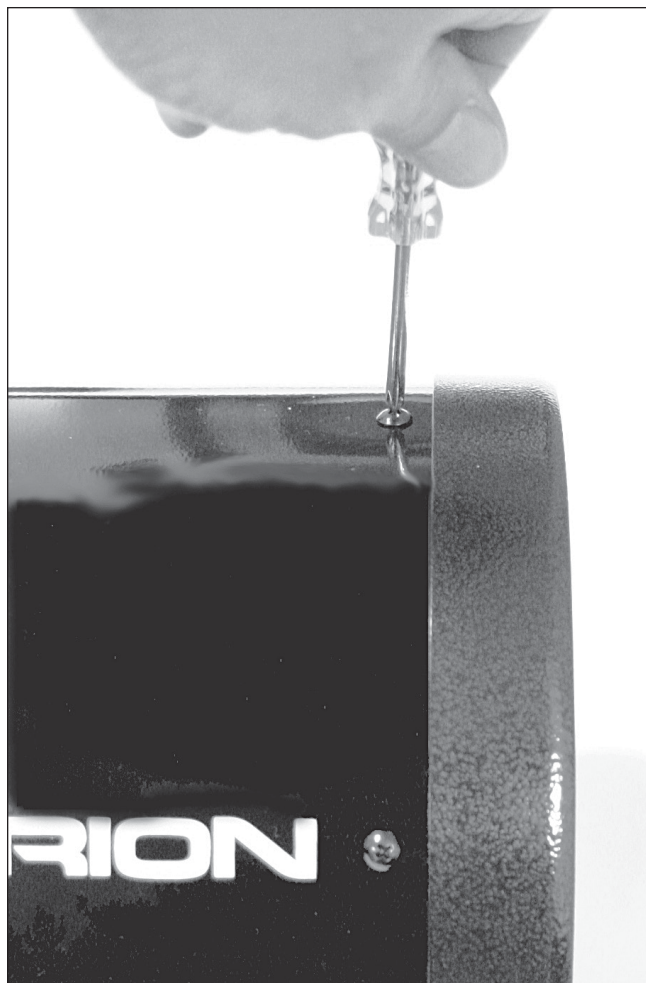
### Cleaning Mirrors

In general, your telescope's mirrors will only need to be cleaned very infrequently, if ever. Covering the front opening of the telescope with the dust cover when it is not in use will prevent dust from accumulating on the mirrors. Keeping the dust cap on the focuser's 1.25" opening is also a good idea. Improper cleaning can scratch the mirror coatings, so the fewer times you have to clean the mirrors, the better. Small specks of dust or flecks of paint have virtually no effect on the visual or imaging performance of the telescope.

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

To clean the secondary mirror, first remove it from the telescope. Do this by keeping the secondary mirror holder stationary while completely unthreading the Phillips-head screw in the center hub of the spider vane assembly (see **Figure 11**). Do not touch the mirror surface when doing this. Once the Phillips-head screw is unthreaded, the secondary mirror and its holder can be removed from the telescope. The secondary mirror does not need to be removed from its holder for cleaning. Then follow the same procedure described below for cleaning the primary mirror.

To clean the primary mirror, first carefully remove the mirror cell from the telescope. To do so you must remove the screws that attach the primary mirror cell and end ring to the tube (**Figure 16**). Then pull the cell away from the tube. You will notice the primary mirror is held in the mirror cell with three clips held by two screws each. Loosen the screws and remove the clips.



**Figure 16.** To clean the primary mirror, it must first be removed from the telescope tube. To do so, remove the Phillips-head screws that fasten the rear cell and end ring to the telescope tube. Then separate the cell from the tube.

You may now remove the primary mirror from its cell. Do not touch the surface of the mirror with your fingers. Lift the mirror carefully by the edges. Set the mirror on a clean soft towel. Fill a clean sink or large bucket with room temperature water, a few drops of liquid dishwashing detergent, and if possible, a capful of 100% isopropyl alcohol. Submerge the mirror (aluminized surface facing up) in the water and let it soak for a few minutes (or hours if it's a very dirty mirror). Wipe the mirror under water with clean cotton balls, using extremely light pressure and stroking in straight lines across the mirror surface. Use one ball for each wipe across the mirror. Then rinse the mirror under a stream of lukewarm water. Any particles on the surface can be swabbed gently with a series of cotton balls, each used just one time. Dry the mirror surface with a stream of air (a "blower bulb" works great). Cover the mirror surface with tissue, and leave the mirror in a warm area until it is completely dry before replacing it in the mirror cell. Then reinstall the mirror cell in the telescope optical tube with the six screws.

## Specifications

### Orion 8" f/3.9 Newtonian Astrograph

Optical configuration:	Newtonian reflector
Aperture:	203mm
Focal length:	800mm
Focal ratio:	f/3.9
Primary mirror:	Low thermal expansion optical glass, parabolic figure
Mirror coatings:	Enhanced aluminum (94% reflectivity) with SiO <sub>2</sub> overcoat
Secondary mirror minor axis:	70mm
Focuser:	Dual-speed (11:1) 2" Crayford, accepts 2" accessories
Drawtube travel:	38mm
Optical tube:	Rolled steel, gloss enamel exterior finish
Tube baffles:	9
Weight:	17.5 lbs. – without tube rings, fan, finder scope, 1.25" eyepiece holder 21.6 lbs. – with tube rings, finder scope, 1.25" eyepiece holder
Length:	30.25"
Tube rings:	Included, hinged, felt-lined
Finder Scope:	9x50, with spring-loaded X-Y dovetail bracket
2" Extension adapters:	30mm and 36mm extension length

### Orion 10" f/3.9 Newtonian Astrograph

Optical configuration:	Newtonian reflector
Aperture:	254mm
Focal length:	1000mm
Focal ratio:	f/3.9
Primary mirror:	Low thermal expansion optical glass, parabolic figure
Mirror coatings:	Enhanced aluminum (94% reflectivity) with SiO <sub>2</sub> overcoat
Secondary mirror minor axis:	82mm
Focuser:	Dual-speed (11:1) 2" Crayford, accepts 2" accessories
Drawtube travel:	38mm
Optical tube:	Rolled steel, gloss enamel exterior finish
Tube baffles:	13
Weight:	25.5 lbs. – without tube rings, fan, finder scope, 1.25" eyepiece holder 30.2 lbs. – with tube rings, finder scope, 1.25" eyepiece holder
Length:	38.6"
Tube rings:	Included, hinged, felt-lined
Finder Scope:	9x50, with spring-loaded X-Y dovetail bracket
2" Extension adapters:	30mm and 36mm extension length

## 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](http://www.OrionTelescopes.com/warranty).



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