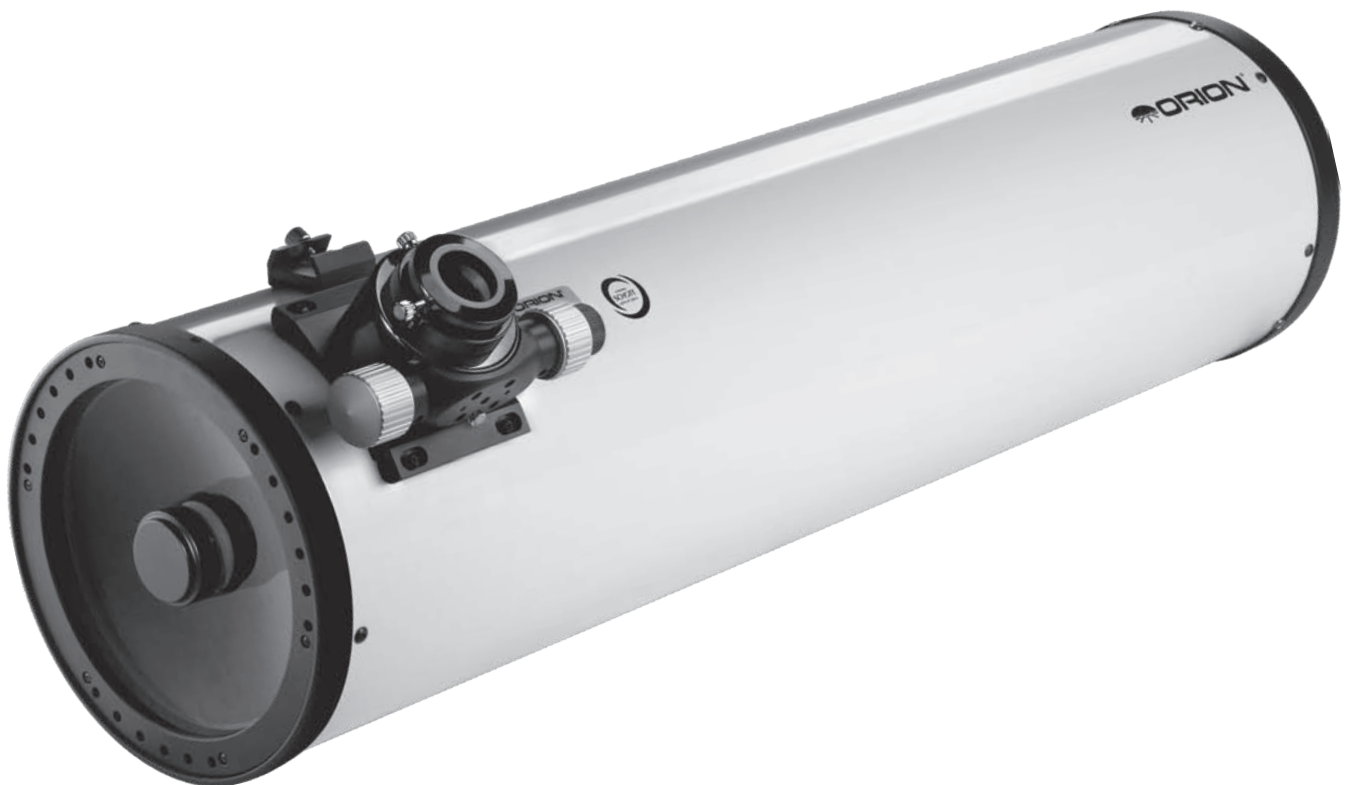


# Orion® Premium 190mm f/5.3 Maksutov-Newtonian Astrograph

#9978

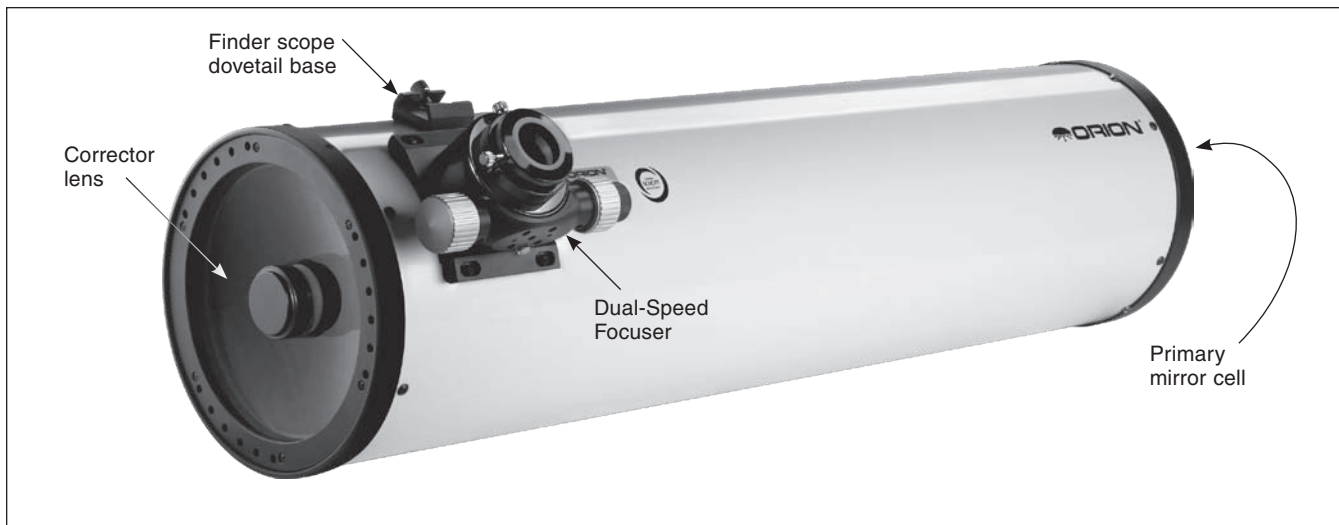


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**Figure 1.** The Premium 190mm f/5.3 Maksutov-Newtonian Astrograph optical tube assembly.

*Congratulations on your purchase of an Orion® Premium 190mm f/5.3 Maksutov-Newtonian Astrograph.* Your 190mm Mak-Newt Astrograph is designed to deliver a flat field across the field of view of an APS (advanced photo system) size camera sensor, such as the StarShoot™ Pro or DSLR imager. Coma is reduced considerably when compared to a Newtonian of equivalent focal length. The exceptional optical and mechanical quality of your 190mm Mak-Newt will provide you with a pleasing telescope experience. The optics are rigidly secured in place to reduce image shift; and diffraction is minimal because the secondary mirror is held by the corrector glass, eliminating the need for spider vanes.

## Parts List

### Optical Tube Assembly

- Optical tube dust cover
- 1.25" eyepiece adapter
- Camera adapter
- 2.5mm hex key
- Phillips screwdriver
- Collimation cap

## Getting Started

Your 190mm Mak-Newt arrives fully assembled from the factory. The optics have been collimated, however you should check the telescope collimation to ensure the collimation held after it was shipped to you (see "Collimation").

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

### Using 1.25" and 2" Accessories

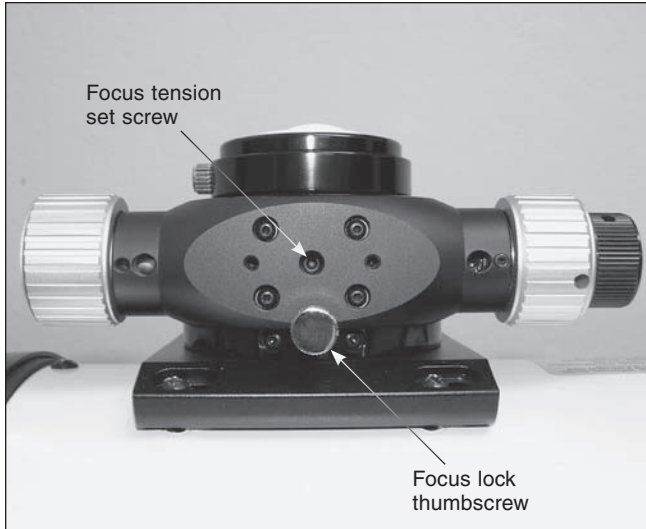
Your 190mm Mak-Newt can accommodate both 1.25" and 2" accessories, including just about any eyepiece or camera. The Crayford focuser has a 2" eyepiece holder with a 1.25" eyepiece adapter installed. Both the 2" eyepiece holder and 1.25" eyepiece adapter feature a brass compression ring to hold your accessories in place. The brass compression ring securely holds the 1.25" or 2" accessory in place without marking up its metal barrel.

### Dual-Speed Crayford Focuser

The 190mm Mak-Newt features a heavy-duty dual speed Crayford focuser, designed to handle the weight of your eyepieces and imaging systems. The Crayford design offers smooth and gradual motion, free of image shift. If the drawtube slips under the weight of your equipment, simply increase the focus tension by tightening the focus tension setscrew (Figure 2).

Crayford focusers generally perform better than rack-and-pinion models because the design eliminates "focus shift". Focus shift is when an image moves position in the eyepiece when it is being focused. This is very hard to eliminate in rack-and-pinion focusers due to slight gear and tolerance imperfections which cause the drawtube to move slightly left or right when focusing. For the Crayford design, the drawtube is constantly tensioned (by the focusing shaft and four "roller bearings") so the drawtube cannot move perpendicular to the desired motion.

The focuser provides the most focus range for accessories that require extra in-travel. With a minimum focus height of 58mm, this focuser is an excellent choice for any astro-imag-



**Figure 2.** Use the focus tension setscrew to adjust the weight capacity of the focuser. Tighten the focus lock thumbscrew to lock the focuser in place.

ing system. The strong machined aluminum construction supports heavy 2" eyepieces as well as heavy camera bodies. The smooth focus motion and fine-focus wheel allow precision adjustments for critical focusing of eyepieces and cameras. Once you have reached focus, you can lock the focuser in place by tightening the focus lock setscrew (Figure 2).

### Fine Focus

The focuser features dual speed adjustment with the fine focus wheel. This small black wheel located on the side of the right-hand focus wheel allows precise focus adjustment at a ratio of 10:1, meaning one turn of the focus wheel equals ten turns of the fine focus wheel.

Use the focus wheels to achieve rough focus on your target object, then use the fine focus wheel to coax out even more detail. You'll be amazed at the amount of detail fine focus adjustments allow you to view on targets such as the lunar surface, planets, double stars, as well as other celestial objects. Alternatively, this focuser is also compatible with the Orion AccuFocus when used with the Dual Speed Bracket (#5049).

### Finder Scope Compatibility

The included finder scope dovetail base on the 190mm Mak-Newt is ready to accept any Orion finder scope.

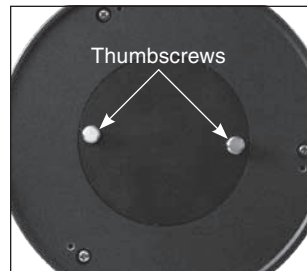
To insert the finder scope onto your 190mm Mak-Newt, slide the finder scope bracket into the finder scope dovetail base and secure it in place by tightening the thumbscrew lock (Figure 3).

## Operating the 190mm Mak-Newt

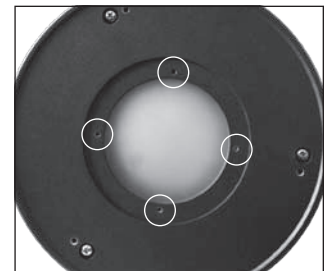
Your 190mm Mak-Newt is suitable for both visual use and imaging. We recommend using high quality eyepieces to take full advantage of the 190mm Mak-Newt's optical quality. For imaging applications, the telescope is optimized for use



**Figure 3.** Slide the finder scope bracket into the finder scope dovetail base and secure it in place by tightening the thumbscrew lock.



**Figure 4a.** Remove the cover plate on the primary mirror cell by unthreading the two thumbscrews that secure it.



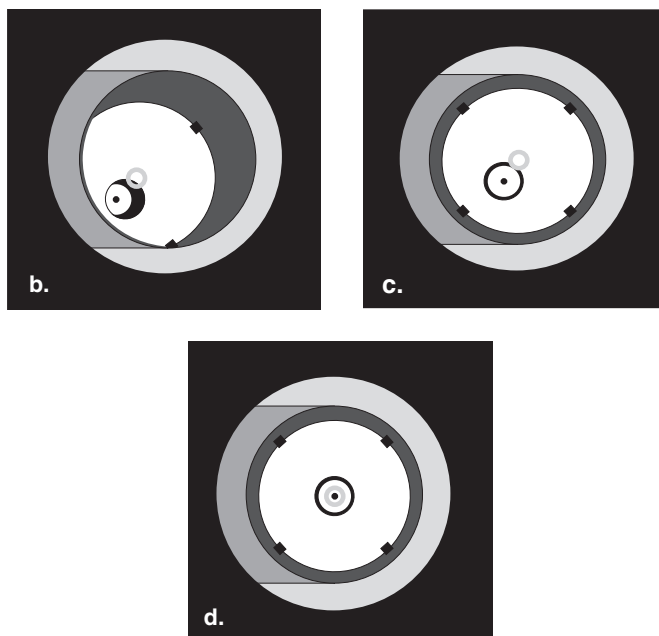
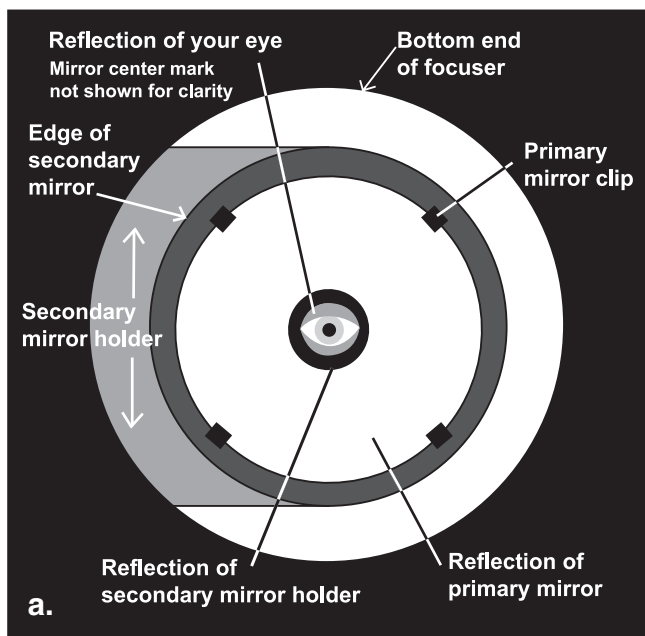
**Figure 4b.** Four tapped holes are provided for an optional attachment of a cooling accelerator fan.

with an APS size sensor, such as the Orion StarShoot™ Pro or a DSLR camera.

### 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.

The 190mm Mak-Newt primary mirror cell is compatible with an optional cooling accelerator fan (available from Orion). Using the fan significantly decreases the amount of time required for the telescope to reach thermal equilibrium. Remove the cover plate on the back of the primary mirror cell (Figures 4a and 4b)



**Figure 5.** Collimating the optics. **(a)** When the mirrors are properly aligned, the view down the focuser drawtube should look like this **(b)**. Here, the secondary mirror is centered under the focuser, but it needs to be adjusted (tilted) so that the entire primary mirror is visible **(c)**. 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 **(d)**.

to gain access to the threaded holes for the cooling accelerator fan attachment.

### Connecting the 190mm Mak-Newt to a Mount

The 190mm Mak-Newt requires a pair of tube rings and a dovetail mounting plate compatible with large Orion mounts, such as the Sirius or Atlas EQ-G. The optical tube is compatible with 235mm I.D. tube rings (available from Orion).

Balancing the 190mm Mak-Newt can be achieved by sliding the dovetail mounting plate forward or backward within the mount’s dovetail holder. You can also move the telescope forward or backward within the tube rings. The tube rings offer the most adjustment range. Loosen the tube ring clamps slightly and slide the telescope tube forward or backward as needed to reach optimum balance, then retighten the tube ring clamps. Rotating the telescope to achieve a comfortable eyepiece angle is done in the same fashion. Simply loosen the tube ring camps just enough to allow the optical tube to rotate within the tube rings. Tighten the tube ring clamps securely once you have reached the desired eyepiece orientation.

### Imaging with the 190mm Mak-Newt

The Premium 190mm Maksutov-Newtonian Astrograph is ideal for just about any imaging camera, from small webcam or planetary imagers, to DSLRs and large CCD cameras. The Maksutov-Newtonian optics reduce the coma and field curvature, which allows you to utilize the entire imaging area of your camera without the need to crop the edges of your astro-images.

Imaging equipment is often much heavier than an eyepiece. The Crayford focuser is capable of handling the weight of your CCD or DSLR camera. Adding tension to the focuser drawtube

(Figure 2) will increase the amount of weight the focuser can handle. Install your camera onto the supplied camera adapter on the focuser during the day. Check the focuser for any slippage. If the focuser drawtube slides under the weight of the camera, you will need to add more tension to the focuser.

### Using a DSLR Camera

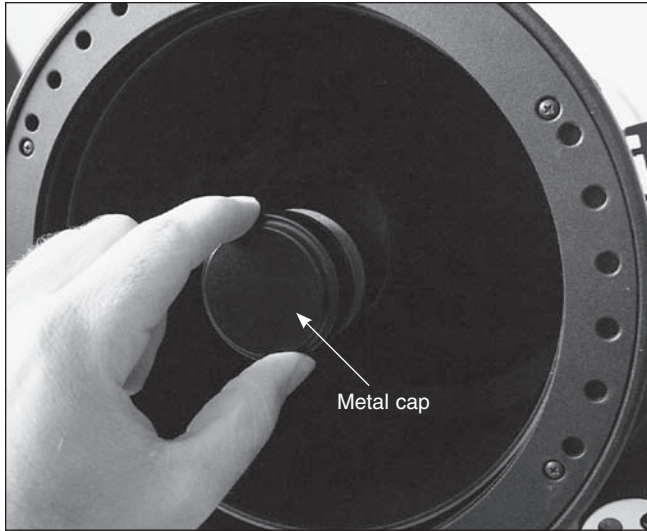
To attach a DSLR camera, all you will need is the appropriate T-ring for the make and model of your camera, and the supplied camera adapter. Simply attach the T-ring to the camera body and thread the 2" prime focus camera adapter into the T-ring. Insert the barrel of the camera adapter into the focuser’s 2" eyepiece holder and secure it with the eyepiece thumbscrew.

### Using a CCD Imager

Most CCD imagers will have a 1.25" or 2" barrel ready to attach directly to your telescope like an eyepiece. No adapter is required. Simply insert the barrel of the CCD camera into the 1.25" or 2" eyepiece holder and secure the camera with the silver thumbscrew lock.

## Collimating the Optics (Aligning the Mirrors)

Collimating is the process of adjusting the mirrors so they are aligned with one another. Your telescope’s optics were aligned at the factory, and should not need much adjustment unless the telescope is handled roughly. Accurate mirror alignment is important to ensure the peak performance of your telescope,



**Figure 6.** Unthread the metal cap that covers the secondary mirror collimation screws.

so it should be checked regularly. Collimating is a relatively easy process and can be done in daylight.

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 5a. If anything is off-center, proceed with the following collimating procedure.

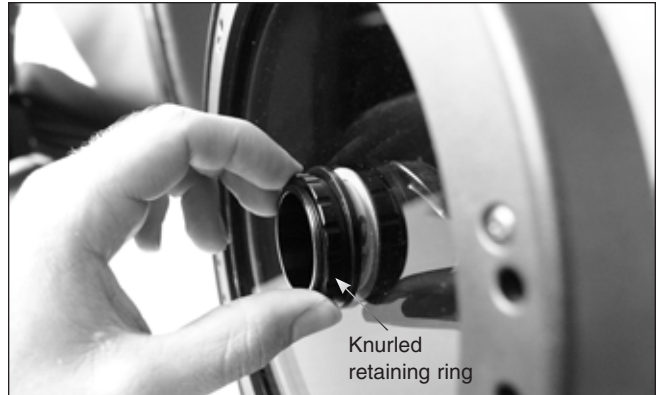
### The Collimation Cap and Mirror Center Mark

Your 190mm Mak-Newt comes with a collimation cap. This is a simple cap that fits on the focuser drawtube like a dust cap, but has a hole in the center and a silver bottom. This helps center your eye so that collimating is easy to perform. Figures 5b through 5d assume you have the collimation cap in place. In addition to providing the collimation cap, you'll 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.

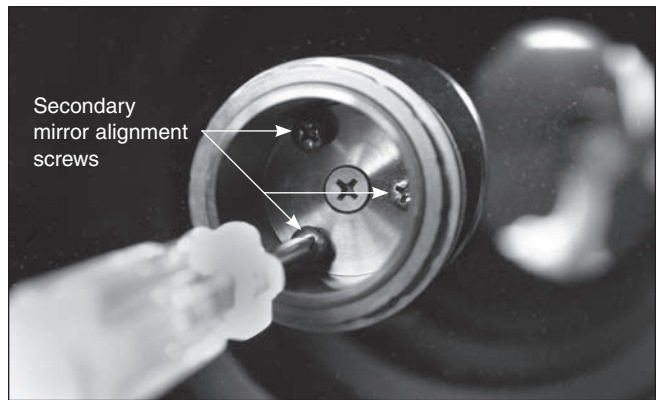
**NOTE: The center ring sticker need not ever be removed from the primary mirror. Because it lies directly in the shadow of the secondary mirror, its presence in no way adversely affects the optical performance of the telescope or the image quality. That might seem counterintuitive, but it's true!**

### 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. The secondary mirror should face the focuser. If the mirror appears to be tilted away from the fo-



**Figure 7.** Loosen the knurled retaining ring on the secondary mirror holder to allow the secondary mirror holder to rotate.



**Figure 8.** Use a Phillips head screw driver to make adjustments to the three secondary mirror alignment setscrews.

cusser, the mirror rotation will need to be adjusted. Typically, this adjustment will rarely, if ever, need to be done. It helps to adjust the secondary mirror rotation in a brightly lit room with the telescope pointed toward a bright surface, such as white paper or wall.

To adjust the secondary mirror rotation:

1. Remove the metal cap that covers the secondary mirror collimation screws by carefully unthreading it (Figure 6). Be careful not to touch the corrector glass.
2. Loosen the knurled retaining ring on the secondary mirror holder (Figure 7) about  $\frac{1}{4}$  turn, or enough to free the tension in the ring.
3. Carefully grab the inside of the secondary mirror holder with your thumb and index finger and rotate the secondary mirror holder as needed so that the secondary mirror faces the focuser.
4. Retighten the knurled retaining ring and make sure it does not cause the secondary mirror to shift or rotate.

The tilt of the secondary mirror may very occasionally require adjustment. If the entire primary mirror reflection is not visible in the secondary mirror when using the collimation cap, as in Figure 5c, you will need to adjust the tilt of the secondary mirror. Using a Phillips head screwdriver, loosen one of the three alignment setscrews while tightening the other two (Figure 8).



**Figure 9.** The tilt of the primary mirror is adjusted with three pairs of collimation screws.

Do not loosen the center screw. The goal is to center the primary mirror reflection in the secondary mirror, as in Figure 5d. Don't worry that the reflection of the secondary mirror (the smallest circle, with the collimation cap "dot" in the center) is off-center, since that adjustment is made when aligning the primary mirror in the next step

### Aligning the Primary Mirror

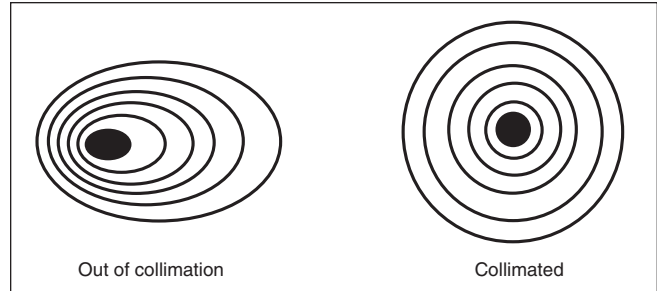
The final adjustment is made to the primary mirror. It will need adjustment if, as in Figure 5d, the secondary mirror is centered under the focuser and the reflection of the primary mirror is centered in the secondary mirror, but the small reflection of the secondary mirror (with the "dot" of the collimation cap) is off-center.

The tilt of the primary mirror is adjusted with three pairs of collimation screws (Figure 9). The collimation screws can be turned with a Phillips head screwdriver and a 2.5mm hex key. Each pair of collimation screws work together to adjust the tilt of the primary mirror. The allen-head screw pushes the mirror forward while the Phillips head screw pulls the mirror cell back. One must be loosened and the other tightened by the same amount in order to adjust the tilt.

To adjust the primary mirror tilt:

1. Tighten and loosen one of the pairs of collimation screws by one turn.
2. Look into the focuser using the collimation cap 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.
3. Repeat this process on the other two pairs of collimation screws, if necessary. It will take a little trial and error to get a feel for how to adjust the mirror to center the "dot" of the collimation cap in the ring of the mirror mark.

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 5d. Make sure all the collimation screws are tight (but do not over tighten), to



**Figure 10.** 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 right if optics are perfectly collimated. If circle is unsymmetrical, as in illustration on left, scope needs collimation.

secure the mirror tilt. 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. Slowly de-focus the image with the focusing knob. If the telescope is correctly collimated, the expanding disk should be a perfect circle (Figure 10). 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.

### Lateral Support System

One of the exciting new features of this telescope is lateral support screws to secure the position of both the primary mirror and corrector plate which will further stabilize the optics. These screws are visible around the perimeter of the tube on both front and back (Figures 11a and 11b) and have been set at the factory. The Phillips-head screws pictured in Figure 11b are cover screws. The Lateral Support screws can be accessed by adjusting these screws (Figure 11c). No adjustment of this component is necessary when performing routine collimation. If larger adjustments do need to be made simply loosen these support screws slightly. When finished re-tighten just tight enough that you feel the slightest resistance when tightening. Do not over-tighten these screws as pinched optics or other distortions could result.

## Care & Maintenance

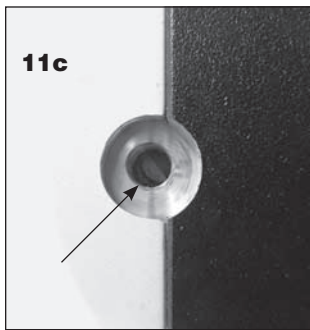
Give your telescope reasonable care and it will last a lifetime. When not in use, keep its dust cover on as well as the dust



11a



11b



11c

**Figure 11a.** The corrector plate Lateral support adjustment screws (one of three shown).

**Figure 11b.** The primary mirror Lateral support cover screw (two of three shown).

**Figure 11c.** Detail of the primary mirror Lateral support adjustment screw (one of three shown).

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.

### Dew

The 190mm Mak-Newt's corrector lens is exposed at the front of the telescope. Without using a dew shield and/or heated dew zapper (available from Orion), dew can easily form on the corrector glass. We recommend using the Orion Dew Zapper Pro™ with the medium aperture heating band (made for 6-8" telescopes) to completely prevent dew from forming on the corrector glass.

When you are ready to pack up your telescope at the end of the night, avoid immediately storing it if you encountered heavy dew and the telescope is damp. Instead, bring the telescope inside and allow the moisture on the telescope to evaporate. If dew forms on the inside or outside of the corrector lens, then leave the dust cover off of the telescope until all the moisture has evaporated. Once the telescope has completely dried out, place the dust cap on the telescope and store it in a dry location.

### Cleaning Optical Surfaces

In general, your telescope will only need to be cleaned on a very minimal basis. Dust particles on the corrector lens will not affect the optical quality of your 190mm Mak-Newt. Fortunately, because the 190mm Mak-Newt is a closed tube design, the primary and secondary mirrors will barely accumulate any dust (if dust caps are kept on during storage). Loose dust can simply be blown off with air, using a compressed air can or blower bulb (available from Orion). Any remaining dust is best left alone, unless the build up is extreme. Finger prints and water marks should be cleaned from your telescope's corrector lens. Any quality optical lens tissue and cleaning fluid specifically designed for multi-coated optics can be used to clean the telescope's corrector lens as well as the lenses of the eyepieces and finder scope. Never use regular glass cleaner or cleaning fluid designed for eyeglasses. Before cleaning with fluid and tissue, however, blow any loose particles off the lens with a blower bulb or compressed air, or lightly brush the lens with a soft camel hair brush. 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! Clean only a small area at a time, using a fresh lens tissue on each area. Never reuse tissues.

## Specifications

### Premium 190mm (7.5") f/5.3 Maksutov-Newtonian Astrograph

Optical configuration:	Maksutov-Newtonian
Aperture	190mm (7.5")
Focal length:	1000mm (39.37")
Focal ratio:	f/5.3
Secondary mirror minor axis:	64mm
Baffles:	5 knife-edge baffles
Focuser:	Machined aluminum dual-speed (10:1) Crayford, accepts 1.25" or 2" accessories, brass compression ring fitting
Drawtube travel:	30mm
Primary mirror:	Low thermal expansion glass
Mirror coatings:	Enhanced aluminum (94%) with SiO <sub>2</sub> overcoat
Meniscus corrector lens:	BK-7 Schott glass, fully multi-coated
Lens cell:	Machined aluminum
Optical tube:	Seamless aluminum
Outside diameter:	235mm (9.25")
Weight:	10 kg (22 lbs.)
Length:	95.25cm (37.5")

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## **One-Year Limited Warranty**

The Orion Premium 190mm f/5.3 Maksutov-Newtonian Astrograph 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 to: Orion Warranty Repair, 89 Hangar Way, Watsonville, CA 95076. Proof of purchase (such as a copy of the original receipt) is required.

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, and you may also have other rights, which vary from state to state. For further warranty service information, contact: Orion Customer Service (800) 676-1343; support@telescope.com.

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