Collimation of Fixed-Primary Mirror Reflectors

Collimation

Collimation is the process of adjusting the telescope's optical elements so they are aligned with one another. Your reflector telescope's optics were aligned at the factory, and should not need much adjustment unless the telescope was jarred while in transit. Accurate mirror alignment is important to ensure the peak performance of your telescope. And since the mirrors can go out of alignment occasionally, it should be checked regularly.

Collimation is a relatively easy process and can be done in daylight or darkness. 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 1a. If anything is off-center, proceed with the following collimating procedure.

The Collimation Cap

Your Orion reflector telescope comes with a "quick collimation cap," shown in **Figure 2**. 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, making it easier to align the optical components. The reflective surface provides a distinct visual reference that is helpful in centering the mirror reflections**. Figures 1b and 1c** assume that you have the collimation cap in place.

Primary Mirror Center Mark?

The primary mirror of your reflector telescope may or may not have a tiny ring (sticker) marking its center. This "center mark" is helpful in achieving a precise collimation, but it is not needed in telescopes in which the primary mirror was aligned at the factory and fixed in place. If it is there, *do not remove it* as it does not affect the view through the telescope in any way. If there is no ring on the primary mirror, that's OK as it is not needed.

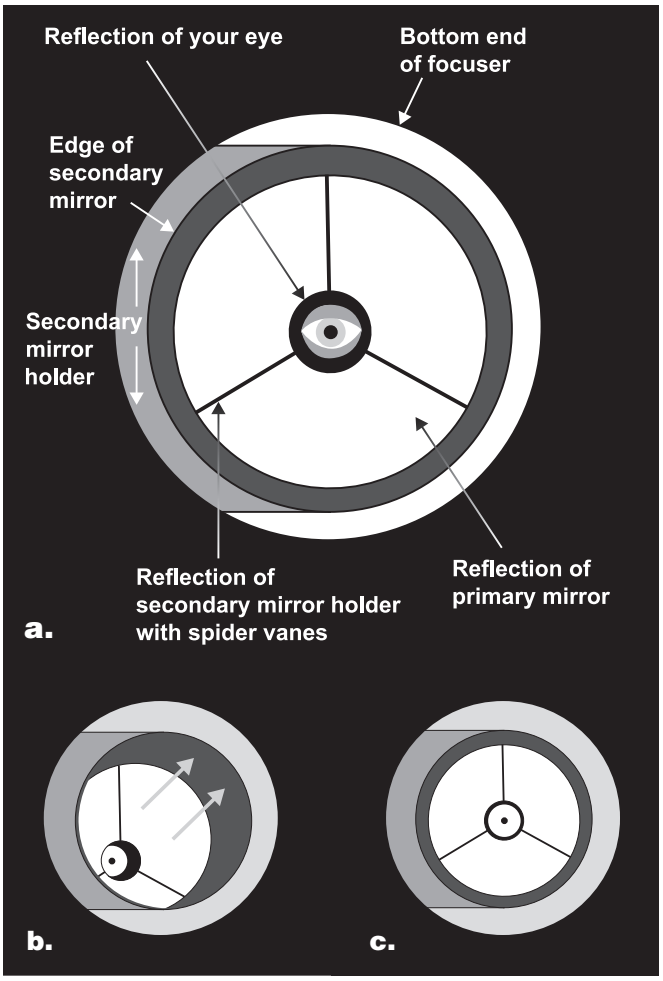

Figure 1. Collimating the optics. **(a)** When the mirrors are properly aligned, the view down the focuser drawtube should look like this; **(b)** With the collimation cap in place, if the optics are out of alignment, the view might look something like this; **(c)** After adjusting the secondary collimation setscrews, the reflection of the primary mirror should be centered in the secondary mirror as shown.

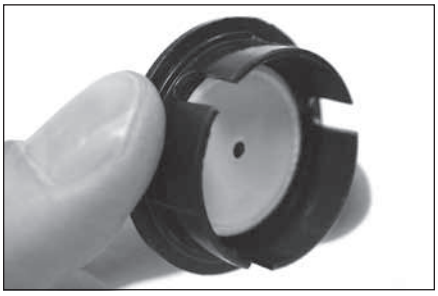

Figure 2. The quick collimation cap, which features a reflective inner surface, helps in centering reflections of the optics in the focuser during the collimation process.

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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Preparing the Telescope for Collimation

Once you get the hang of collimating, you will be able to do it quickly even in the dark. For now, it is best to collimate in daylight, preferably in a brightly lit room and 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 if something comes loose while you are making adjustments. Place a small sheet of white paper inside the optical tube directly opposite the focuser **(Figure 3)**. The paper will provide a bright "background" when viewing into the focuser.

Aligning the Secondary Mirror

To adjust the secondary mirror collimation, you will need to use the correct size of Allen key, which is often a 2mm or 2.5mm key. One may have been included with your telescope.

If the entire primary mirror is not visible in the secondary mirror when using the collimation cap, as in **Figure 1b,** you will need to adjust the tilt of the secondary mirror with the three recessed setscrews surrounding the center screw (**Figure 3**). Using the hex key, first loosen one of the three alignment set screws by no more than ¼ turn, then lightly tighten the other two to take up the slack. Is the primary mirror reflection more centered now? The goal is to center the primary mirror reflection in the secondary mirror, as in **Figure 1c**. It will take some trial and error, but by adjusting the three setscrews a small amount at a time, you should be able eventually to see the whole primary mirror in the secondary mirror.

At the end of the procedure all three setscrews should be tight – but don't overtighten! – to ensure that the secondary mirror can't move.

Aligning the Primary Mirror

The primary mirror of the StarBlast 114mm is fixed in place, so no adjustments to it are necessary, or even possible.

The view through the collimation cap should now resemble **Figure 1c**. A simple star test (see below) 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 4**). 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 may need to make slight corrections to the telescope's position in order to account for the sky's apparent motion. A good star to point at for a star test, for northern hemisphere observers, is Polaris, the North Star, because its position does not move significantly over time.

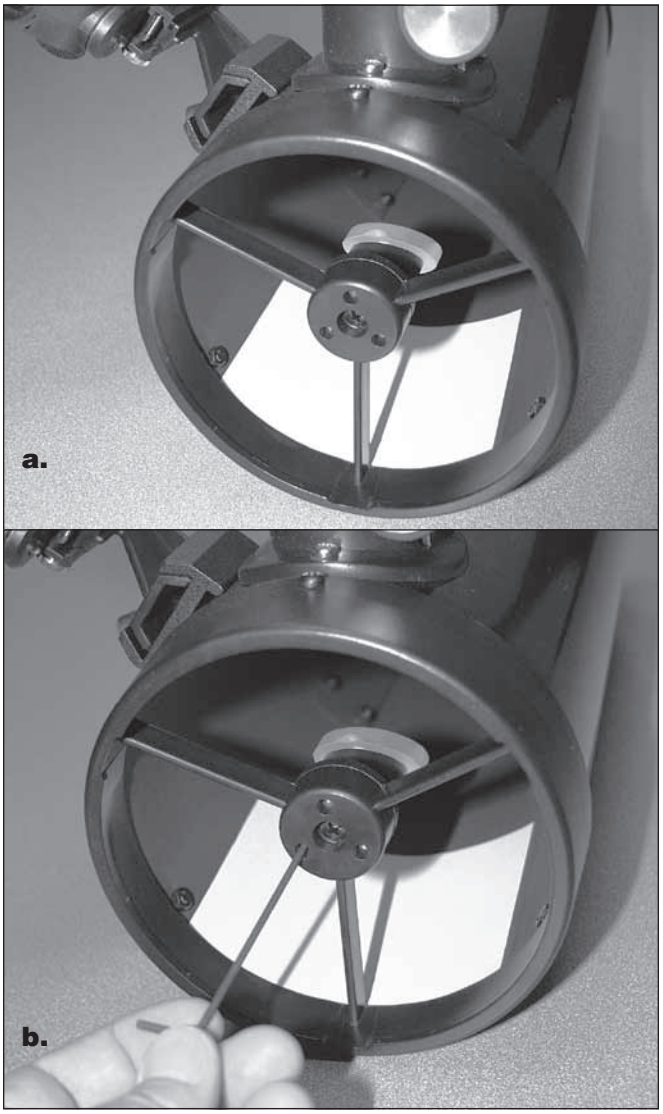

Figure 3. (a) Place a piece of white paper inside the tube opposite the focuser, **(b)** Use a 2mm Allen key to adjust the three collimation setscrews surrounding the center screw of the secondary mirror housing.

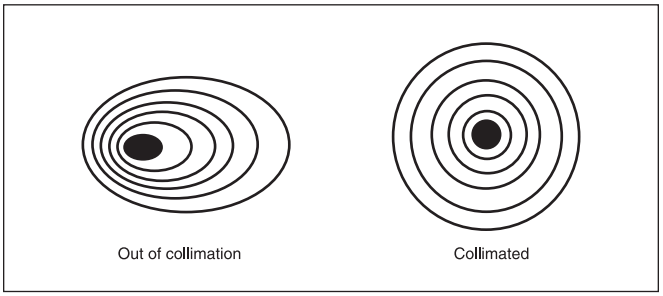

Figure 4. A star test will determine if a telescope's optics are properly collimated. An unfocused view of a bright star through the eyepiece should appear as illustrated on the right if the optics are perfectly collimated. If the circle is unsymmetrical, as on the left, the scope needs collimation.