

# Instruction of Collimating

## *iOptron MAK150*

Collimating is the process of aligning a telescope's optics. Your Maksutov-Cassegrain's primary mirror was aligned at the factory and should not need adjustment unless the telescope is handled roughly. This manual contains information on how to test the collimation of your telescope and instructions for proper alignment should that be needed. **Do not attempt to adjust the collimation screws**, if you have not read through this manual and ready to do the collimation.

### Star-Testing the Telescope

Before you start adjusting the primary mirror of your telescope, make certain that it is actually out of collimation by performing a star test.

Take your telescope out at dusk and let it acclimate to the outside temperature; this usually takes 30-60 minutes. Like all closed Maksutov-Cassegrain systems, the thick meniscus lens and primary mirror of the MAK150 will take some time to cool down to ambient temperature when taken outdoors on a cold winter evening. The cooldown time can be shortened by removing the three plastic plugs in the rear cell of the scope to expose the rear of the mirror cell and placing the scope, meniscus end down, in an unheated garage or protected outdoor space for an hour or so before observing. This will allow the warm air inside the tube to rise and escape out the three one inch apertures in the rear cell.

When it is dark, point the telescope upwards 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 circle (Figure 1). If the image is unsymmetrical, the scope is out of collimation. Also, 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 but 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.

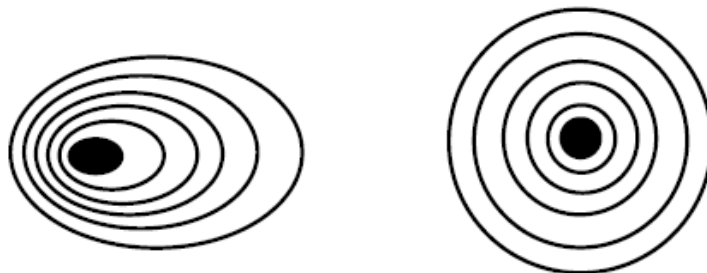


Figure 1. A star test will determine if a telescope's optics are properly collimated. An unfocused view of a bright star through the eyepiece should appear as illustrated on right if optics are perfectly collimated. If circle is unsymmetrical, as in illustration on left, scope needs collimation.

## Collimating

To collimate your telescope, remove the diagonal and eyepiece and look into rear opening of the tube (also remove the dust cover from the front of the tube). This should be done indoors, with the telescope pointed at a white wall in a well-lit room. Try to keep your eye centered with respect to the rear opening of the tube as best as possible. Using a collimating eyepiece will aid greatly in keeping your eye centered and is strongly recommended.

Alternatively, you can make a crude collimating tool out of a long 1.25" plastic lens cap, or an empty, black plastic 35mm film canister. It will not have crosshairs, so it won't be as precise, but it will be better than nothing. Put a 1/16" to 1/8" diameter hole in the center. If you are using a canister, cut 1/2" from the top lip of the canister. Insert the plastic collimating tool into the focuser like an eyepiece with the bottom end out.



Figure 2. Lens cap

Once you are ready to collimate, look into rear opening of the tube. If your telescope is out of collimation, it will resemble Figure 3a. A properly collimated scope will resemble Figure 3b. The direction of the misalignment in your telescope may differ from Figure 3a, but the diagram will give you the general idea of how things will look.

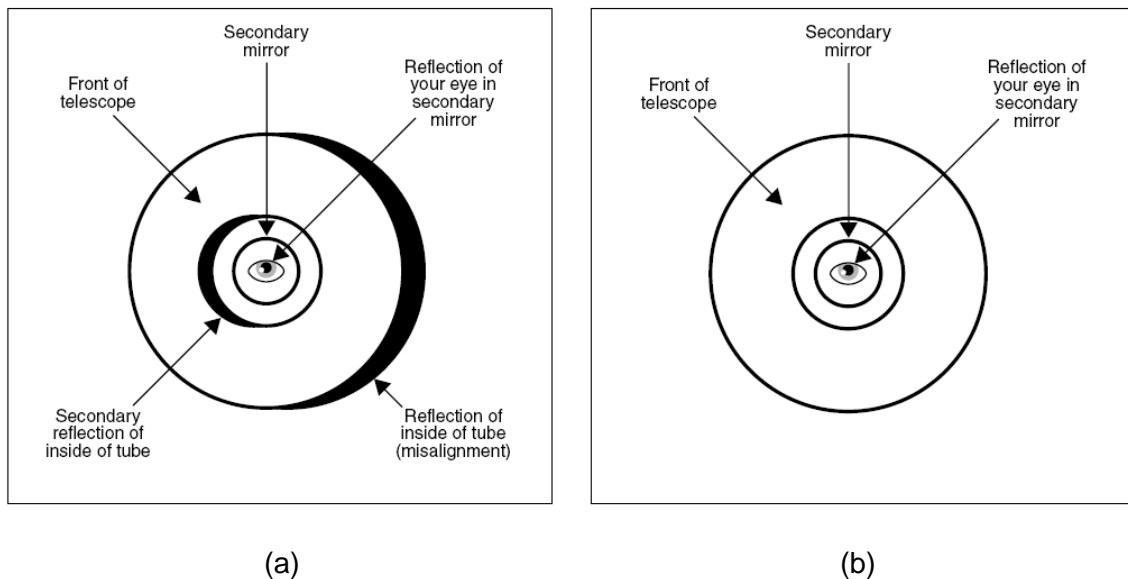


Figure 3. If the telescope's optics are out of alignment the view through the rear opening of the telescope will resemble Figure 3a. With the optics properly aligned the view through the rear opening of the telescope will resemble Figure 3b.

Remove 3 plastic screw covers on the rear cell of the optical tube. There are 3 sets of hex head screws. Every set of screws includes a push screw and a pull screw, as indicated in Figure 4. These alignment screws push and pull the mirror cell in order to tilt it. When you loosen or tighten one of these screws, the other five screws must be adjusted as well to keep the proper amount of pressure on the back of the mirror cell. By making slight adjustments, no more than a  $\frac{1}{4}$  turn, to how much the screws are tightened and loosened, you will change the alignment of the primary mirror.

Look into the rear opening of the tube and locate the black crescent that shows the telescope is out of alignment (Figure 3a). Note which way the front of the telescope would need to move in order to “fill” that black crescent and resemble Figure 3b. Then look at the back end of the telescope and locate the alignment screw that is in the direction that the front of the telescope needs to move. For example, if the view in your telescope resembled Figure 3a, then you would want to move the front opening of the telescope to the right. The alignment screw you would start with would be the screw on the right as shown in Figure 4.

Before starting working on the screws, check if any of them is loose, especially the push screws. Your actions now depend on whether this alignment screw is a push or pull screw. Please note that you will be working to adjust the mirror cell by keeping all the screws not too loose and not too tight. Follow the steps listed below carefully and refer to the figures that accompany them.

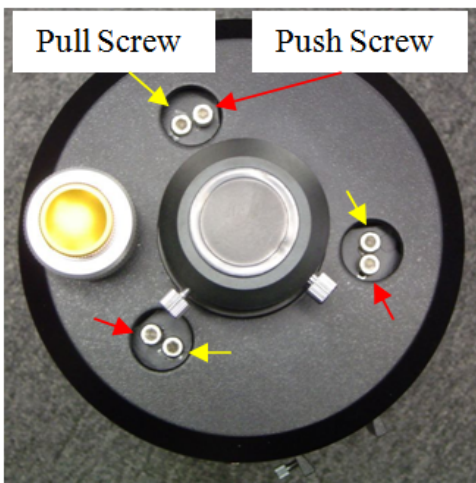


Figure 4. There are three sets of alignment screw. Each set includes a push screw and a pull screw, indicated by red and yellow arrows, respectively. The push screws stand out higher from the surface than the pull screws.

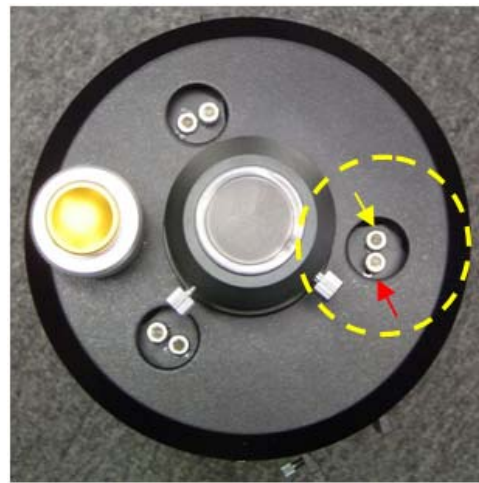


Figure 5 If the view through the rear opening of the telescope resembled Figure 3a, then the alignment screw set you would start with would be this set of screws marked by dashed yellow circle. The actual set of alignment screw you would pick will vary depending on which way the front opening would need to move in order to “fill” the black crescent.

#### Notes:

- A 4mm metric Allen wrench should be used to turn the push or pull screw.
- Each time, the push or pull screw should be turned only a small amount, **NO MORE THAN  $\frac{1}{4}$  TURN.**

***If the alignment screw is a push screw (need pushing the mirror inward)***

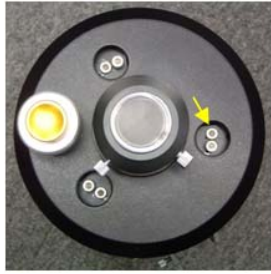


Figure 6a. Turn the pull screw **counterclockwise** a small amount, no more than a  $\frac{1}{4}$  turn. (Note: actual selected alignment screw will vary.)

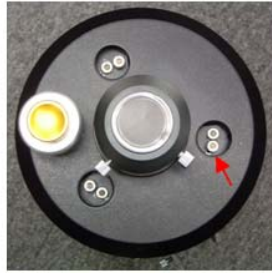


Figure 6b. Now, turn the push screw in the same set **clockwise** no more than  $\frac{1}{4}$  turn.

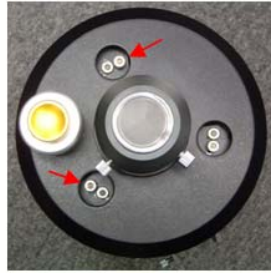


Figure 6c. Locate the push screws in the other two screw sets and turn them **counterclockwise** no more than  $\frac{1}{4}$  turn.

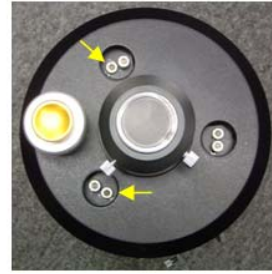


Figure 6d. Turn the two pull screws in these two sets **clockwise** no more than  $\frac{1}{4}$  turn.

First, turn the pull screw **counterclockwise** a small amount, no more than a  $\frac{1}{4}$  turn (Figure 6a).

Now, turn the push screw in the same set (Figure 6b) **clockwise** no more than  $\frac{1}{4}$  turn.

Locate the push screws in the other two screw sets (Figure 6c) and turn them **counterclockwise** no more than  $\frac{1}{4}$  turn.

Turn the two pull screws in these two sets (Figure 6d) **clockwise** no more than  $\frac{1}{4}$  turn.

Repeat the above steps until the front opening is centered in the direction you wanted it to go. You may need to repeat this (or the pull screw adjustment process) with other screws in order to align it in other directions.

***If the alignment screw is a pull screw (need pulling the mirror outward)***



Figure 7a. First, turn the push screw **counterclockwise** a small amount, no more than a  $\frac{1}{4}$  turn. (Note: actual selected alignment screw will vary.)

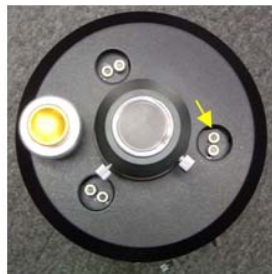


Figure 7b. Now, turn the pull screw in the same set **clockwise** no more than  $\frac{1}{4}$  turn.



Figure 7c. Locate the pull screws in the other two screw sets and turn them **counterclockwise** no more than  $\frac{1}{4}$  turn.

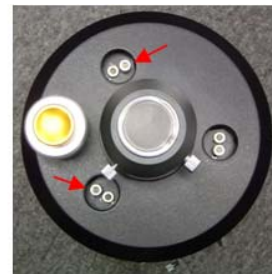


Figure 7d. Turn the two push screws in these two sets **clockwise** no more than  $\frac{1}{4}$  turn.

First, turn the push screw **counterclockwise** a small amount, no more than a  $\frac{1}{4}$  turn. (Figure 7a)

Now, turn the pull screw in the same set (Figure 7b) **clockwise** no more than  $\frac{1}{4}$  turn.

Locate the pull screws in the other two screw sets (Figure 7c) and turn them **counterclockwise** no more than  $\frac{1}{4}$  turn.

Turn the two push screws in these two sets (Figure 7d) **clockwise** no more than  $\frac{1}{4}$  turn.

Repeat the above steps until the front opening is centered in the direction you wanted it to go. You may need to repeat this (or the push screw adjustment process) with other screws in order to align it in other directions.

Repeat these two procedures as needed until the view through the scope resembles Figure 3b.

### ***Finishing Collimation***

Once you have finished adjusting your telescope, you will need to perform another star test (described earlier) to check the collimation. If your telescope appears collimated after star testing, it should not need adjustment again unless it is roughly handled.