COLLIMATING A SCHMIDT CASSEGRAIN TELESCOPE

Before collimating, a brief explanation of SCT optics is required. Commercially made SCTs all have small errors in optical alignment, figure and mechanical alignment. Typically the optical error is in the centering of the secondary mirror. Consequently, when a laser is placed into the back of a Schmidt Cassegrain Telescope the beam will seldom return dead center, even though star testing would indicate perfect collimation. The secondary mirror of an SCT magnifies any error by about 5 times. Typically, a well collimated SCT will return a laser beam .125" to .250" off center.

Due to the slight alignment errors of SCT optics and mechanics, it is not possible to use a Laser collimator in the same manner as it would be used with a Newtonian telescope. Regardless, very accurate collimation of an SCT is easily accomplished using a laser if the following procedures are accurately followed. This is a one time process and after this the laser may be used exclusively to bring your SCT quickly and easily into accurate optical alignment.

SOME DO'S AND DON'T'S

1. Only try to collimate on solid ground, concrete or asphalt. NEVER try to collimate on wooden floors, carpeted floors or any other surface that will flex or vibrate.
2. NEVER make adjustments to your secondary mirror or to the laser placement on the paper target that are greater than 50% of the observable error. In fact, we recommend making adjustments that are within 25% to 40% (described in detail below).
3. Only use the provided SCT Adapter to hold the laser and eyepiece. NEVER remove the adapter during the collimation process or involve other accessories that are not described in the process.
4. When focusing the laser onto the paper target, turn your focuser SLOWLY. The beam will come into and go out of focus quickly and it is easy to miss if you are focusing quickly. The beam is not an intense red beam. It is fairly easy to see but do not expect to see the usual type of brightness associated with a laser.
5. If you cannot resolve the laser on the target you may either be focusing too quickly, too close to the target or it may be too bright outside. Either slow down your focusing, move your target farther away or wait until the evening to collimate when it is darker outside.

Collimating

1. Tape the paper target that came with your collimator up on a wall at a distance that corresponds to slightly more than your telescope's *close focus.

2. It is necessary to attach the hollow SCT adapter first (remove the laser from the adapter), and with the use of a 2" to 1.25" adapter (included with most 2" focusers or available through Kendrick Astro Instruments), insert your eyepiece and then visually center the target. IMPORTANT!! You must connect the laser and the 2" to 1.25" adapter (with the eyepiece inserted into it) with the included 6" fishing leader. The top of the laser has a small hole in it through which the hook at the end of the leader may be attached. The other end of the leader may be secured around the thumbscrew of the 2" to 1.25" adapter. Having these items connected like this will take up any slack in the declinaton clutch brought about by the weight of the laser. The weight must be constant, This is CRUCIAL for good collimation. SEE DRAWING 1A (PAGE 5)

3. Focus on and center the paper target visually in the eyepiece. Start with a low power eyepiece so that the target may be located easily. Then go to a high power eyepiece or use a guiding eyepiece and center the target in this eyepiece. If you are using a guiding eyepiece then simply put the crosshairs of the paper target in the crosshairs of the eyepiece. If your eyepiece does not have cross hairs then use the circles on the target as a visual reference against the edge of the field of view within the eyepiece. Leaving the telescope directed at the target, and being careful not to bump the scope out of alignment from the target, insert your laser into the adapter.

4. Turn the laser on and using your binoculars, a small telescope or your friend, look at the target.
You may notice that the target pattern now has a diffuse ball of light around it. If you do not, turn your focus knob until you focus the laser down to a ball of light that is about 10mm in diameter. This ball of light is being projected onto the target by the primary mirror of the SCT and is following the precise optical path that your telescope is currently collimated on. This light is the extraneous scattered light that surrounds all laser beams. It is being bounced off the secondary mirror onto the primary mirror and out through the front of the telescope while the main beam of the laser is being directed back to the face of the collimator. The ball of light on the paper target will be quite obvious. If it is not obvious and you have tried to focus, you are still too close to the target. You will need to move your telescope or the target, further apart and start again.

Ideally, the ball of light should be exactly centered on the paper target. If it is not, adjust the

secondary mirror to compensate for NO MORE than 50% of the error. In other words, if you can see that the ball of light is .5" off center, then make an adjustment that is no more than 50% of .5" towards center, or .250". This previous point is extremely important and is the main reason some people have difficulty collimating using a laser. If you keep your adjustments to a maximum of 40% you will do fine. Have your friend or use your binoculars to check your adjustments. This procedure is very accurate and very tight collimation can be achieved if you are careful.

Having made your first adjustment to the secondary mirror, remove the laser and insert the eyepiece again (Of course, as you remember, the eyepiece is in its 2" to 1.25" adapter and is secured to the laser by a length of string or thin wire). Look through the eyepiece at focus on the paper target. You will now observe that the target is no longer in the center of the eyepiece **(SEE ILLUSTRATION A)**. Using your fine adjustment knobs for Declination and Right Ascension, make adjustments that will compensate for NO MORE than 50% of the difference of error you observe through the eyepiece. In other words, if the target appears to be .250" off center when looking through the eyepiece, then make adjustments that will compensate for no more than .125". DO NOT PLACE THE TARGET DEAD CENTER **(SEE ILLUSTRATION B**). As I have described in the previous para-graph, adjustments that are greater than 50% of the observable error will decollimate your telescope.

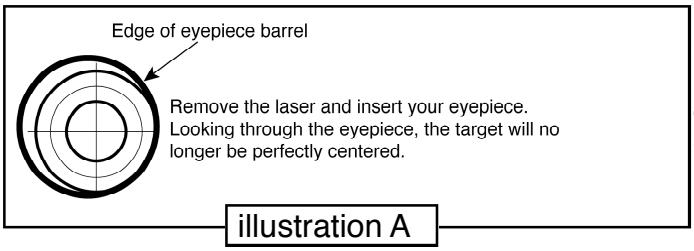


illustration A

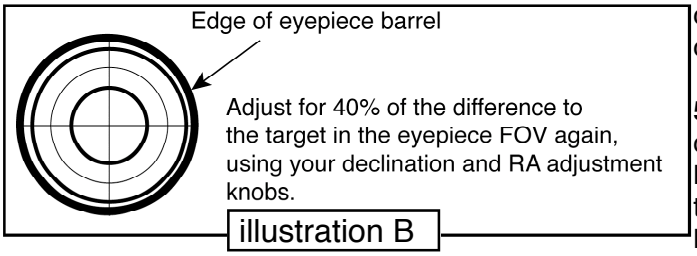


illustration B

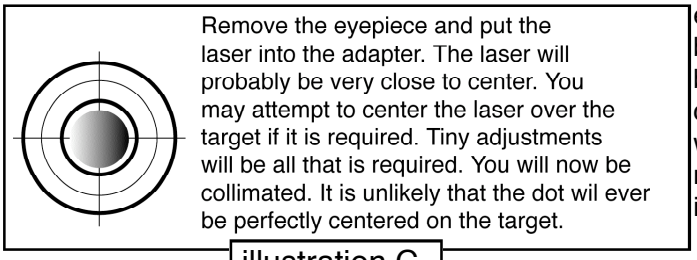


illustration C

Remove the eyepiece and put the laser back into the SCT adapter. Focus the laser light on to the paper target. Again, adjust for NO MORE than 50% of the observable error from dead center. Remove the laser and repeat the process with the eyepiece. Keep doing this until no more adjustments need to be made **(SEE ILLUSTRATION C)**.

It is likely that you will never get the laser to be exactly dead center on the target. This is due to minor optical and mechanical axis errors inherent within the scope.

5. Once you are satisfied that you have centered the ball of light on the target accurately, check the face of the laser collimator located in the adaptor on the back of your telescope. Look for the return beam on the face of the collimator. It will be a blob of light about 5mm in diameter. Stick the small paper label included with your SCT collimator onto the face of the laser where this beam returns to. This will resolve the beam to a small red dot or black circle surrounded by a couple of diffraction rings. Mark the central spot within the diffraction rings. This spot is where you will collimate to in all future collimation procedures. The laser may now be used exclusively to collimate your SCT without having to go back to any of the above procedures.

The advantages of this process is that you are collimating at least 5 times the focal length normally used when collimating using the single star method. Consequently, collimation is at least 4 to 5 times more accurate. The farther you put the target away, the more accurate it will be as you are increasing the F ratio of the collimation beam.

*"Close focus" is the point of closest focus you can use on your telescope. Compare the measurements indicated on the page with the target with your telescope owner's manual to determine close focus for your telescope. In order to address the common problem of mirror shift in SCTs, it is always advisable to turn the focuser clockwise after any counter clockwise adjustments. This will set the mirror at a common point when taking the scope in and out of focus during the collimation process.

COLLIMATING A MAKSUTOV NEWTONIAN

Collimating a Mak-Newt is exactly the same as collimating a standard Newtonian telescope. Follow the Newtonian collimation instructions included with your collimator.

COLLIMATING MAKSUTOV CASSEGRAIN & RITCHEY CHRETIEN CASSEGRAIN TELESCOPES

SOME DO'S AND DON'T'S

1. Only try to collimate on solid ground, concrete or asphalt. NEVER try to collimate on wooden floors, carpeted floors or any other surface that will flex or vibrate.
2. NEVER make adjustments to your secondary mirror or to the laser placement on the paper target that are greater than 40% of the observable error.
3. Only use the provided SCT Laser Adapter to hold the laser and eyepiece. NEVER remove the adapter during the collimation process or involve other accessories that are not described in the process.
4. When focusing the laser onto the paper target, turn your focuser SLOWLY. The beam will come into and go out of focus quickly and it is easy to miss if you are focusing quickly. The beam is not an intense red beam. It is fairly easy to see but do not expect to see the usual type of brightness associated with a laser.
5. If you cannot resolve the laser on the target you may either be focusing too quickly, too close to the target or it may be too bright outside. Either slow down your focusing, move your target farther away or wait until the evening to collimate when it is darker outside.

Collimating

1. Place the paper target ,included with your collimator, so that is just beyond the close focus point for your telescope

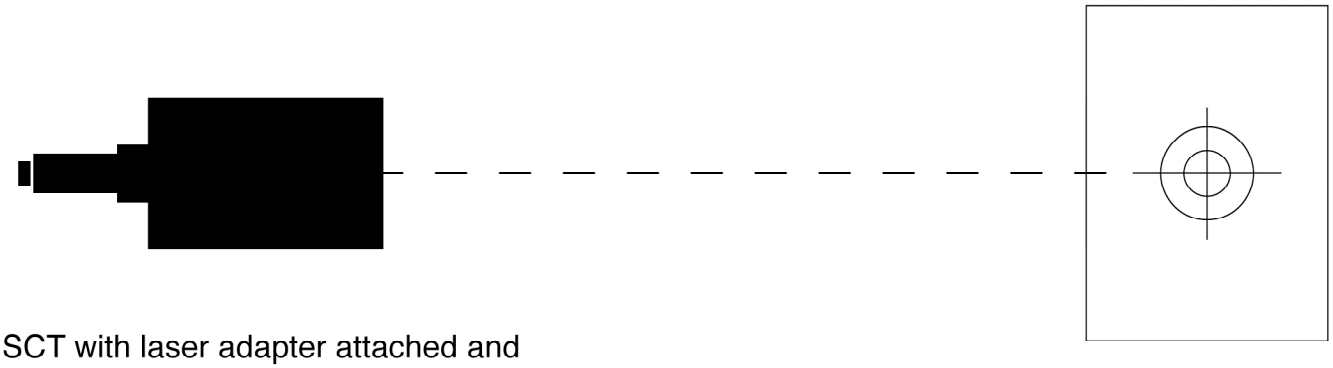
2. Attach the SCT laser adapter to the visual back of the telescope.

3. Place the laser into the adapter and turn the laser on. Look at the laser face through the hole in the side of the SCT laser adapter. Adjust your secondary mirror so that the beam on the face of the laser converges with the exit aperture of the laser. Your secondary mirror should now be collimated.

4. Now remove the laser from the adapter and place the 2" to 1.25" adapter with a low power eyepiece into the adapter. Center the target in the eyepiece. Put in a high power eyepiece (12mm or higher) and center the target again. (It is highly recommended that the Laser collimator and the 2" to 1.25" adapter be connected with a piece of wire or string at all times during the collimation process. The reason for this is to introduce, and keep constant, the flexure in your declination clutch. Flexure is a result of the weight of the collimtor on the weight on the back of your telescope and if it not compensated for then you will actually decolllimate your telescope.

5. Remove the 2" to 1.25" adapter and put in the laser. With the laser turned on, and using the couser on your telescope, focus the beam on the paper target. This usually requires several turns of the foocuser know. You will observe a red 10mm sized ball of light on the paper target. If it is smaller than about 10mm, you have foucsed too far. Make adjustments to your primary mirror that will compensate for NO MORE THAN 40% of the observable error. Put the eyepiece back in and recenter the target in the eyepiece. Put the laser back in and make another adjustment (up to but not exceeding 40%) to the primary mirror. Repeat this process until no more adjustments are needed.

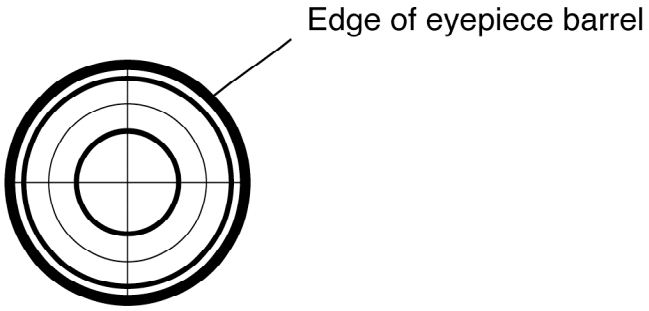
Drawing 1



SCT with laser adapter attached and eyepiece placed into the laser adapter. A 2" to 1.25" adapter is required to use an eyepiece with the Laser adapter. You will need a 2" to 1.25" adapter to hold an eyepiece in the adapter.

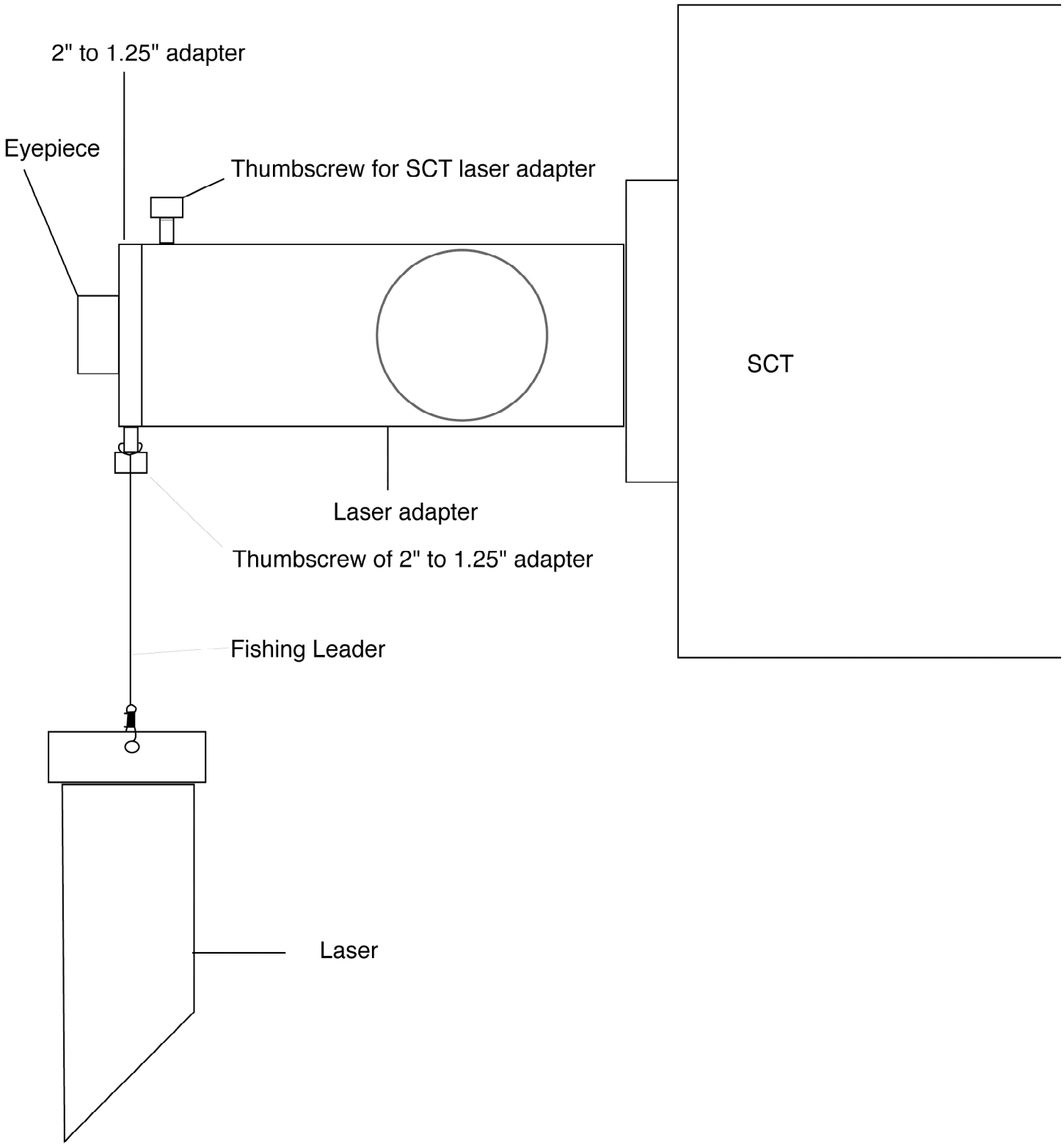
It is recommended that the laser be hung from the back of the adapter in order to take up the flexure in the declination clutch caused by the weight of the laser. The eyepiece should be hung also. See drawing 1A

Target placed on a wall just beyond what is close focus for your telescope .



Step 1
Place the target just beyond close focus for your telescope.
First, use a low power eyepiece to find and center the target in the eyepiece.
Exchange this low power eyepiece with a higher power eyepiece.
Typically a 12mm to 10mm eyepiece will do.
Center the target in the eyepiece as shown above.

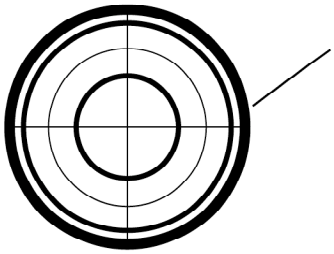
Drawing 1A

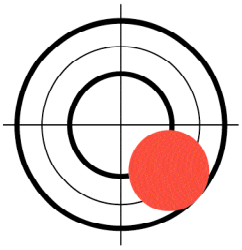


The eyepiece / 2" to 1.25" adapter (not supplied) and the laser should be hung from the back of your telescope in order to take into account the flexure in the declination clutch caused by the weight of these objects. The supplied 6" steel fishing leader can be used to do this. Connect the leader to the thumb screw of the 2" to 1.25" adapter and to the small hole in the top of the laser.

Drawing 2

Edge of eyepiece barrel

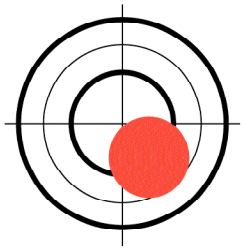


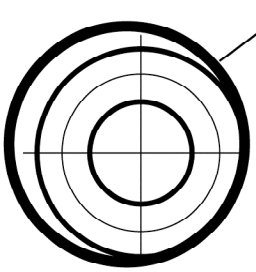


1. Place the target just beyond close focus for your telescope. Focus and center the target in your eyepiece FOV (field of view)as shown above.

2. Remove the eyepiece from the SCT adapter and insert the laser. Focus the laser on the target until it looks something like this. The dot should have a fairly well defined edge.

Edge of eyepiece barrel

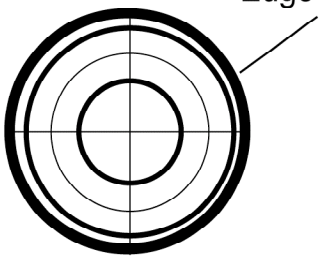


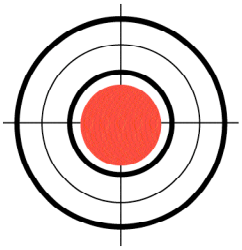


3. Adjust the secondary mirror collimating screws until the red dot is moves NO MORE than 40% of the distance to being centered on the target.

4. Remove the laser and insert your eyepiece. Looking through the eyepiece, the target will no longer be perfectly centered.

Edge of eyepiece barrel

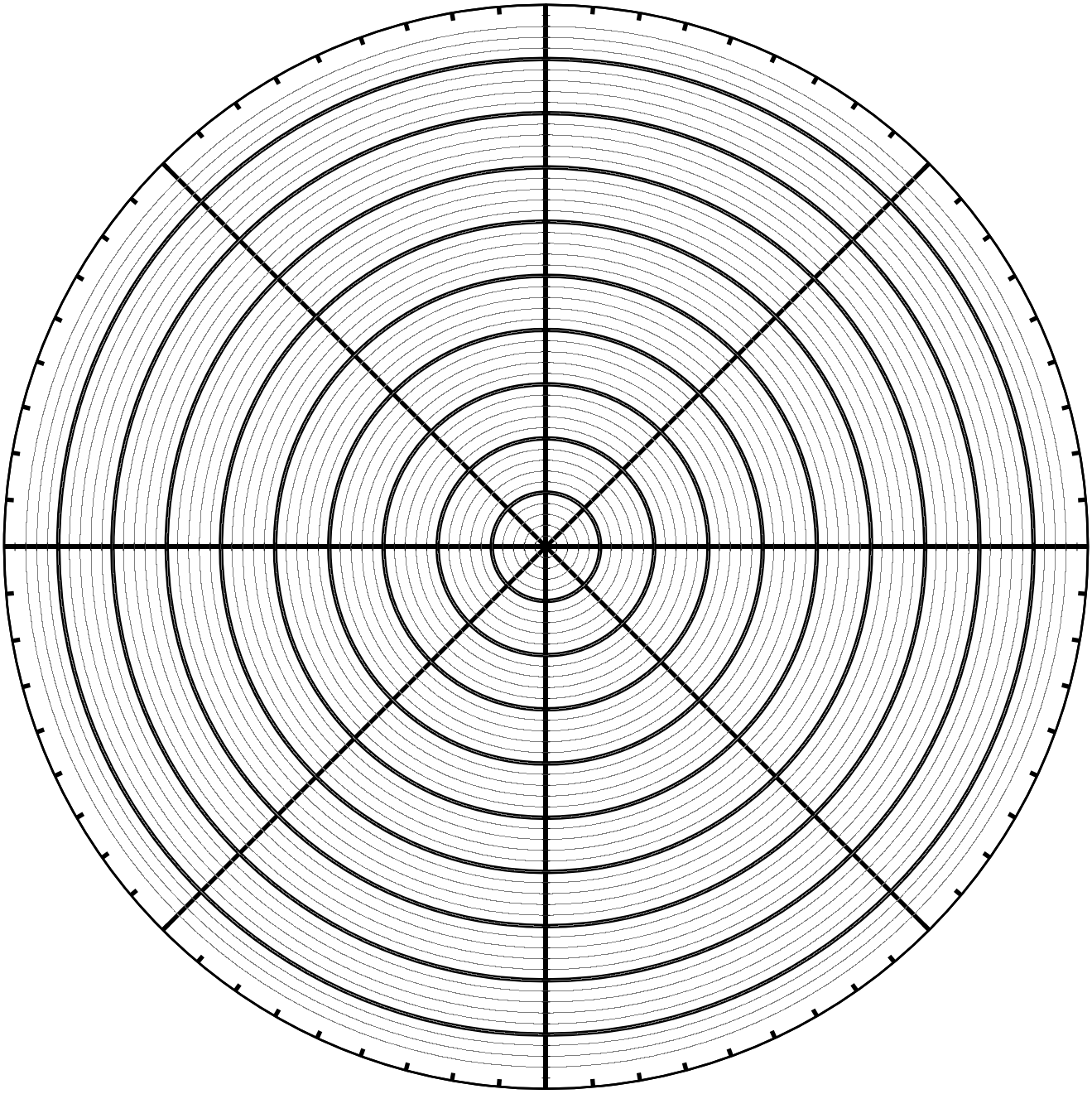




5. Adjust for 40% of the difference to the target in the eyepiece FOV again, using your declination and RA adjustment knobs.

6. Remove the eyepiece and put the laser into the adapter. The laser will probably be very close to center. You may attempt to center the laser over the target if it is required. Tiny adjustments will be all that is required. You will now be collimated. It is unlikely that the dot wil ever be perfectly centered on the target.

DO NOT FORGET TO HANG BOTH YOUR LASER AND EYEPIECE FROM THE ADAPTER WHEN INTERCHANGING BETWEEN THE TWO TO ACCOMODATE FOR DECLINATION CLUTCH FLEXURE.



Recommended close focus distances for various SCTs:

8".....25'
10".....50'
11".....75'
12".....100'
14".....200'

Distances may vary from one telescope to another.

<table>
<tr>
<td rowspan="3"> 
</td>
<td>  </td>
<td>This set screw and the three others around the barrel (the 2069-SB has eight!) are used to hold the laser diode in place. Do not adjust these!</td>
</tr>
<tr>
<td>  </td>
<td>Nylon Set Screws. These may be adjusted with a small jewelers screwdriver to take up andy slack that may exist between your focuser and the collimator. Additionally, you will note that there are 4 of these screws. You only need to adjust three of them. Which three depends on your focuser. For deeper focusers adjust #1, #2 and #4.

For shallower focusers use #1, #2 and #3.

These nylon screws will nicely triangulate and stabilize your collimator in your focuser, removing any wobble. Kendrick is the only company that offers this feature to their laser collimators! Older collimators will only have two of these set screws.</td>
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<tr>
<td>  </td>
<td>This set screw is the one that holds your lid in place and will give you access to the collimator's batteries. Use the Allen wrench included with your collimator to undo this set screw. Be careful not to lose. it is only 1/8" long! The #2069-SB does not have this set screw and has a thumbscrew instead.</td>
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