RB-14.5 and RB-16

Owner's Manual

WARNING

Viewing the sun without proper equipment can cause permanent blindness.

JMI Telescopes
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Introduction

The RB (Reverse Binocular) telescope system is an innovative dual-telescope binocular system in a single transportable package. It is covered by U.S. Patents No. D499,436 and 6,297,917.

We make every effort to ensure that each RB-14.5 and RB-16 is built to the highest quality standards. We hope that your new telescope gives you many thousands of hours of enjoyment, and that your pleasure in this precision instrument matches the pride we take in our work.

Checking for Shipping Damage

In an effort to reduce in-transit damage, each RB is shipped with a shock detection device called a Shockwatch™ attached to the outside of the crate. If the shock indicator has turned red this shows that the crate has been handled more roughly than we would like. In that case, make a notation on the delivery document (with the signature of the delivery person if possible) then contact JMI directly as soon as possible.

Getting Started

We want you to begin enjoying your RB-14.5 or RB-16 as soon as possible, however you should first carefully read the instructions in "Assembling the RB-14.5 and RB-16."

The binocular is designed to be easily disassembled, transported and reassembled to let you take advantage of the dark skies away from city lights as well as celestial phenomena not visible from your home base. Once you are familiar with the steps, assembly can take less than ten minutes.

Warning

Sunlight magnified through the RB-14.5 and RB-16 can cause instantaneous and permanent blindness, severe burns or fire. Keep the aperture covers in place when the RB is not in use.

Collimation

Each RB-14.5 and RB-16 is collimated before shipment and should require only minor adjustment from time-to-time. As with all Newtonians, some minor collimation adjustments will need to be made from time to time (see page 21). If you make a collimation adjustment you will need to realign the two tubes by using the convergence motors (see pages 17 and 19). <u>If the two optical systems are not collimated properly, it may be difficult to converge the two images into one.</u>

Optional Accessories

The following accessories extend the capabilities of your RB-14.5 and RB-16. They can be ordered at any time, and you will find them easy to use or install.

Light Shrouds
Optional truss-rod light shrouds block stray light and air currents and help keep dust off of the mirrors. They are made of light-weight black fabric with elastic at both ends and they come in a set of two, one for each optical tube.

Handlebar and Wheels
For wheelbarrow-style transportation, use our optional Handlebar and Wheels to easily move the fully assembled binocular telescope over smooth surfaces. It uses 5" solid-rubber ball-bearing wheels.

NGC-microMAX Computer with 245 Object Database
A small, lightweight unit with an eight-character red LED display that provides a real-time display of the telescope's Right Ascension and Declination. A guide feature assists the user in locating any of the 245 objects in its database, including 90 stars, the entire Messier catalog and 28 user-definable objects.

NGC-MAX Computer with 12,000+ Object Database
In addition to the Sun and planets, the NGC-MAX database contains nearly a thousand stars, the entire NGC catalog, and most of the IC catalog. A polar align feature greatly eases the task of polar aligning the telescope. An identification feature will search the internal database for the object nearest the telescope's current pointing position, assisting with identification of unfamiliar objects or suggesting possible new targets. A serial port allows a personal computer to obtain information about the telescope's current position—useful for applications such as Software Bisque's THESKY™.

NGC-superMAX Computer with 29,000+ Object Database
The NGC-superMAX (Argo Navis) operates basically the same as the other MAX computers but with more modes and user-adjustable parameters. It includes the following modes: Align, Align Star, Az Alt, Catalog, Encoder, Fix Alt Ref, Identify, RA Dec, Setup, Sidereal, Status, Time, Timer and Tour. There are over 29,000 objects including about 1,100 which are user-definable. The LCD display has a heater option for very cold weather. Free software and database upgrades are available as a download from the internet. The system includes a free computer mounting bracket. See www.wildcard-innovations.com.au for more information from the manufacturer.

SGT-MAX Software Guided Telescope System with Desktop Planetarium Software
This IBM PC compatible software beautifully represents the night sky on your computer screen, showing the position of the telescope and guiding you to any object. It provides extremely detailed information on each object, shows common names of objects, and allows you to toggle constellation lines on or off. The SGT-MAX plots current planetary positions, can zoom from 235° to one arc-minute fields of view, and is completely mouse-driveable. The software is available in assorted database sizes.

Specifications

Feature	Description
Type	Dual Newtonian reflectors
Mount	Alt-Az mount on a Pier
Mirrors	14.5" f/4.5 primary mirrors, 3.5" diagonal secondary mirrors (RB-14.5), 16" f/4.5 primary mirrors, 3.5" diagonal secondary mirrors (RB-16)
Focusers	Modified RCF-1 with motor
Eyepieces	30mm wide angle
Clearance Between Optical Tubes	8"
Eyepiece Spacing	Variable from 2" to 3.25"
Optical Alignment	Motorized x and y axis for optical tube alignment
Finder	Star Pointer
Power	6 volts DC 4.5 amp-hour battery with 110vAC/60Hz charger (Optional 220vAC/50Hz charger available)
Binocular Weight	Approx. 155 lbs (RB-14.5), 175 lbs (RB-16)
Pier Weight	Approx. 29 pounds
Binocular Height	69" (RB-14.5), 77.5" (RB-16) (Vertical position on pier) 34" (RB-14.5), 36" (RB-16) (Horizontal position on pier)
Binocular Width	45" (RB-14-5), 46" (RB-16)
Binocular Depth	22" (RB-14.5), 22.5" (RB-16)
Binocular Tube Length	59" (RB-14.5), 66" (RB-16)

Assembling the RB-14.5 and RB-16

Your RB-14.5 or RB-16 is mostly assembled at the factory. With the following instructions and associated pictures, the final steps should be as easy as 1-2-3.

Uncrating the Instrument

The contents of the crate are shrink-wrapped to hold everything stationary. After removing all items from the crate you should have the parts pictured in Figure 1, plus an accessories box. If you purchased the Handlebar and Wheels option, the tow handle will be included. If you ordered shrouds, they will be installed on the optical tube assemblies as shown in Figure 1.

Figure 1
Tub and Pier section (A), Center Section (B) and Optical Tube Assemblies (C)

Assembling the Instrument

The first step in assembly is to attach the center section (see Figure 2). Be sure to match the cutout (D) in the center section to the cutout in the frame. Secure the center section to the frame with the eight (8) black and orange thumbscrews (see Figure 2 inset) found in the hardware bag. The encoder cables (wrapped around the centerpiece in Figure 2) will be connected later.

Figure 2

Next, remove the dust covers from the top of the tubs. Place the optical tube assembly on top of the tub (Figure 3) and position so that the eyelets (E) at the bottom of the optical tube assembly line up with the threaded inserts (F) in the tub. There is a small score mark (G) on the eyelet (see Figure 4). Rotate the optical tube assembly until the score mark is in the center of the threaded insert. Secure the assembly with the black T-handle thumbscrews found in the hardware bag. Make sure that the focusers are on the inside facing each other.

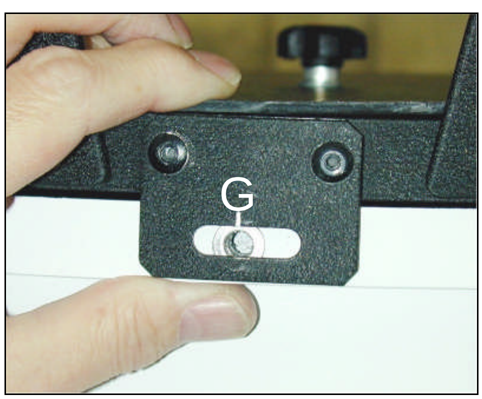


Figure 3 (top) and Figure 4 (bottom)

Place the dust cover inside the truss rod cage as shown in Figure 5. The cover is flexible and it is easier to install if you lift one side of the cover to get it past the truss rods.

Figure 5

There are two motors that move the optical tubes to converge the images (Figure 6). As seen from the guiding handlebar side of the telescope (from which all references will be made) the Left/Right (L/R) motor (H) is on the right and the Up/Down (U/D) motor (I) is on the left. These motors move the optical tubes, either to the left and right (L/R) or up and down (U/D), to converge the images in the eyepiece.

Connect the two motors to their corresponding optical tubes by bringing the optical tube up to where the drive screw of the motor is coming out of the ball. The drive screw has been immobilized in the ball by a rubber band. The screw is in a position that will be very close to where it should be when the telescope is in use. There are two screws (J), on either side of the ball, that allow you to tighten or loosen the bracket's grip on the ball to allow the ball to rotate and line up the screw for easier assembly. Line the threaded drive screw up with the brass coupler on the end of the motor shaft. Note the indentation in the flat of the screw shaft (K). Insert the shaft so the indentation is in line with the set screw and the set screw can seat in the indentation (Figure 7). This will prevent the shaft from coming out. You will have to tilt the motor a little bit to get the shaft into the coupler. The motors are mounted on small o-rings to prevent binding and to allow this tilt for proper assembly. Snip off the rubber bands after the motors are connected.

NOTE: When the images are finally converged in the eyepieces the two focusers will not always be on the same plane. One may be slightly offset from the other requiring a slight tilt of the head to observe through the binocular.

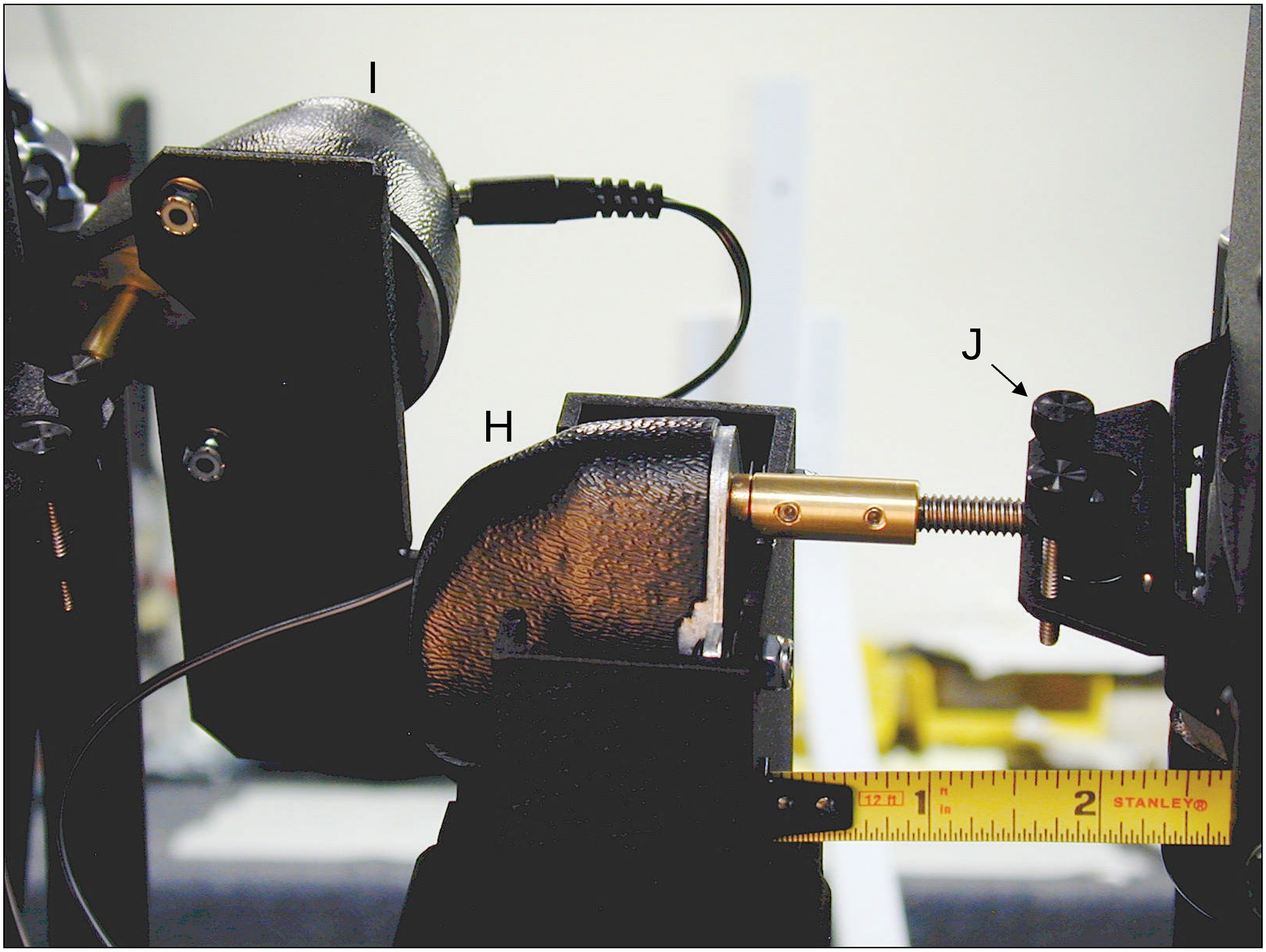


Figure 6

Figure 7

There are three cables coming out of either side of the guiding handlebar Command Center (Figure 8). You will need to plug these into their respective jacks. The top cables are for the L/R and U/D motors and should already be plugged in. The middle cables are for the eye-spacing motors on the focusers and the bottom cables are for the cylindrical focus motors. If you have a shroud, there is a small hole (L) in the shroud for the focus motor cable to pass through (Figure 9).

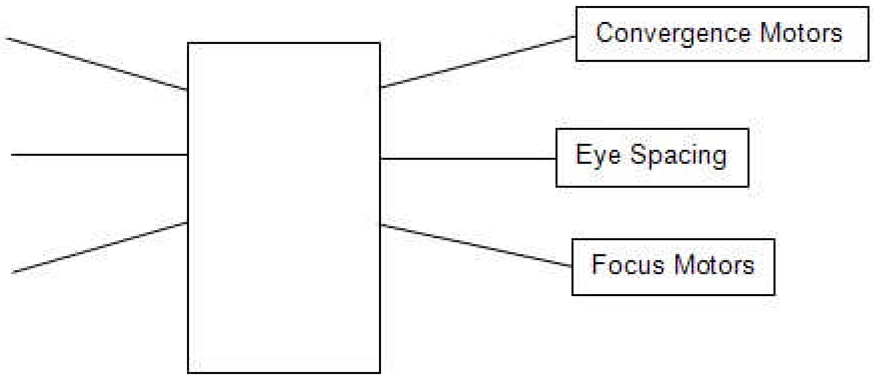


Figure 8

Figure 9

The Command Center buttons are as follows (see Figure 10):

1. L/R and U/D motors.
2. Switch for selecting between the L/R and U/D motors.
3. Eye-spacing motors.
4. Focus motors (in and out for left and right tubes).
5. Two black T-handle thumb knobs for tightening and loosening the guiding handlebar so it can fold up if needed.

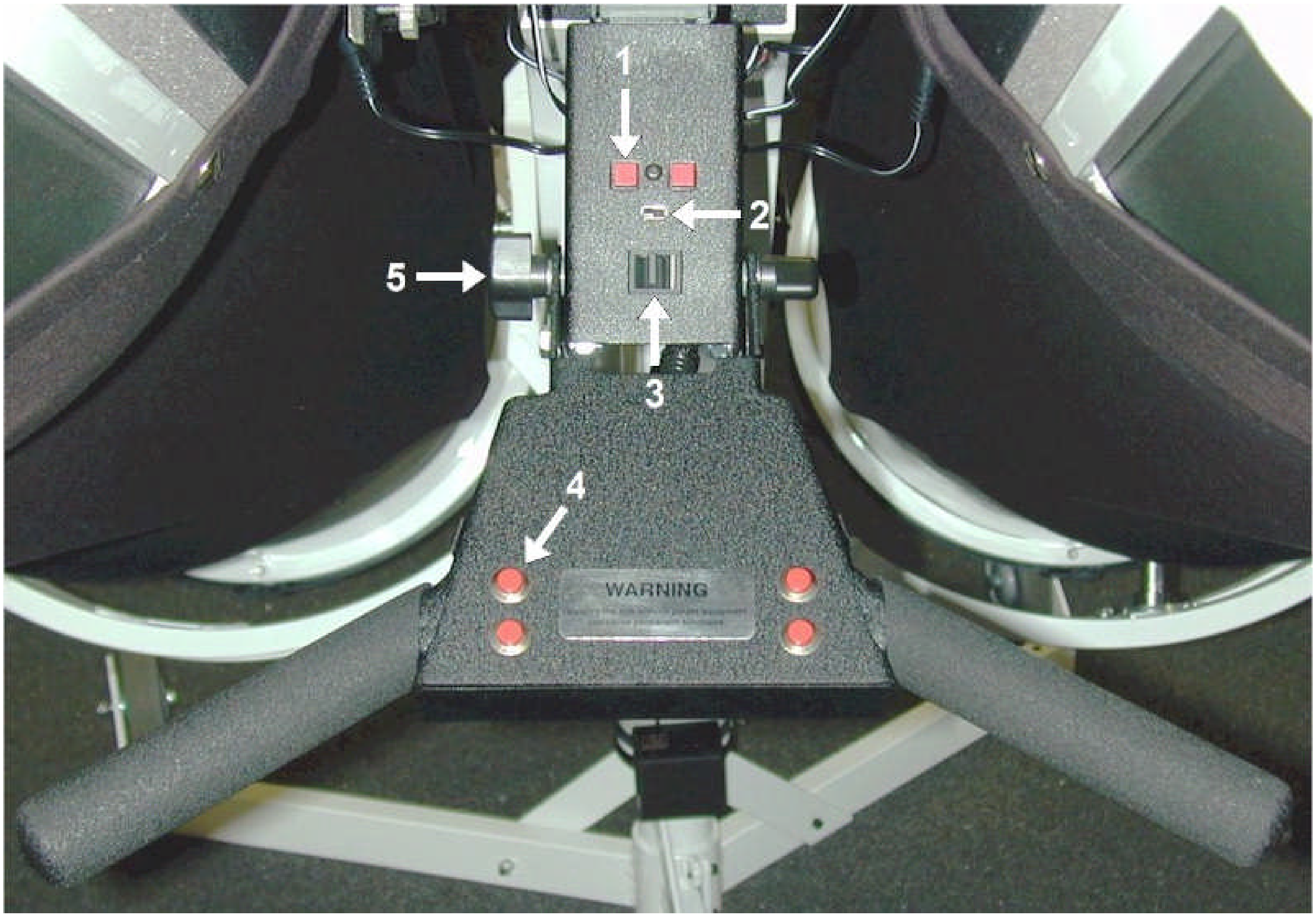


Figure 10

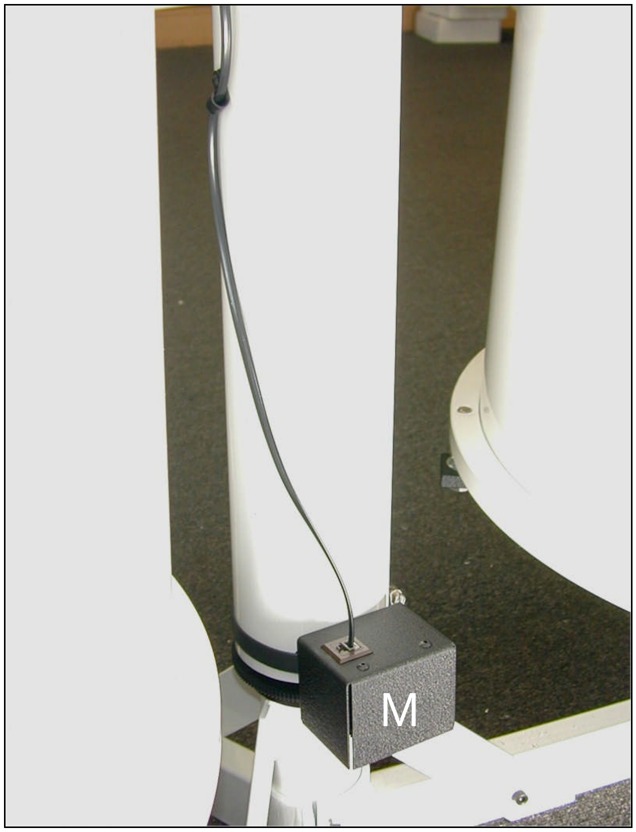


Figure 11

The altitude and azimuth encoder cables are wrapped around the centerpiece as shown in Figure 2. The short cable goes to the altitude encoder located on the right side of the altitude bolt. The long cable goes through a guide clip and is routed down the pier and into the azimuth encoder (M) at the bottom of the pier (Figure 11).

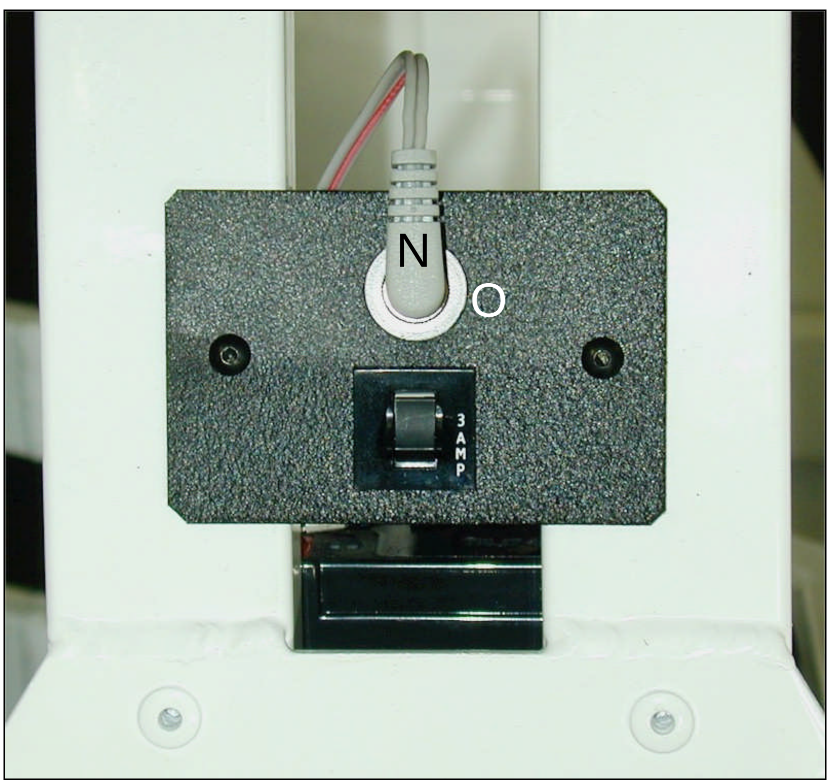


Figure 12

The power cable (N) comes out of the centerpiece opposite the encoder cables (see Figure 12). Plug the power cable into the power jack (O). You can now test all the motors, but try not to move them too far in either direction as they have been set up at the factory to be very close to the position where you will need them. To charge the battery, plug the charger cable into the power jack (O) and leave it plugged in overnight.

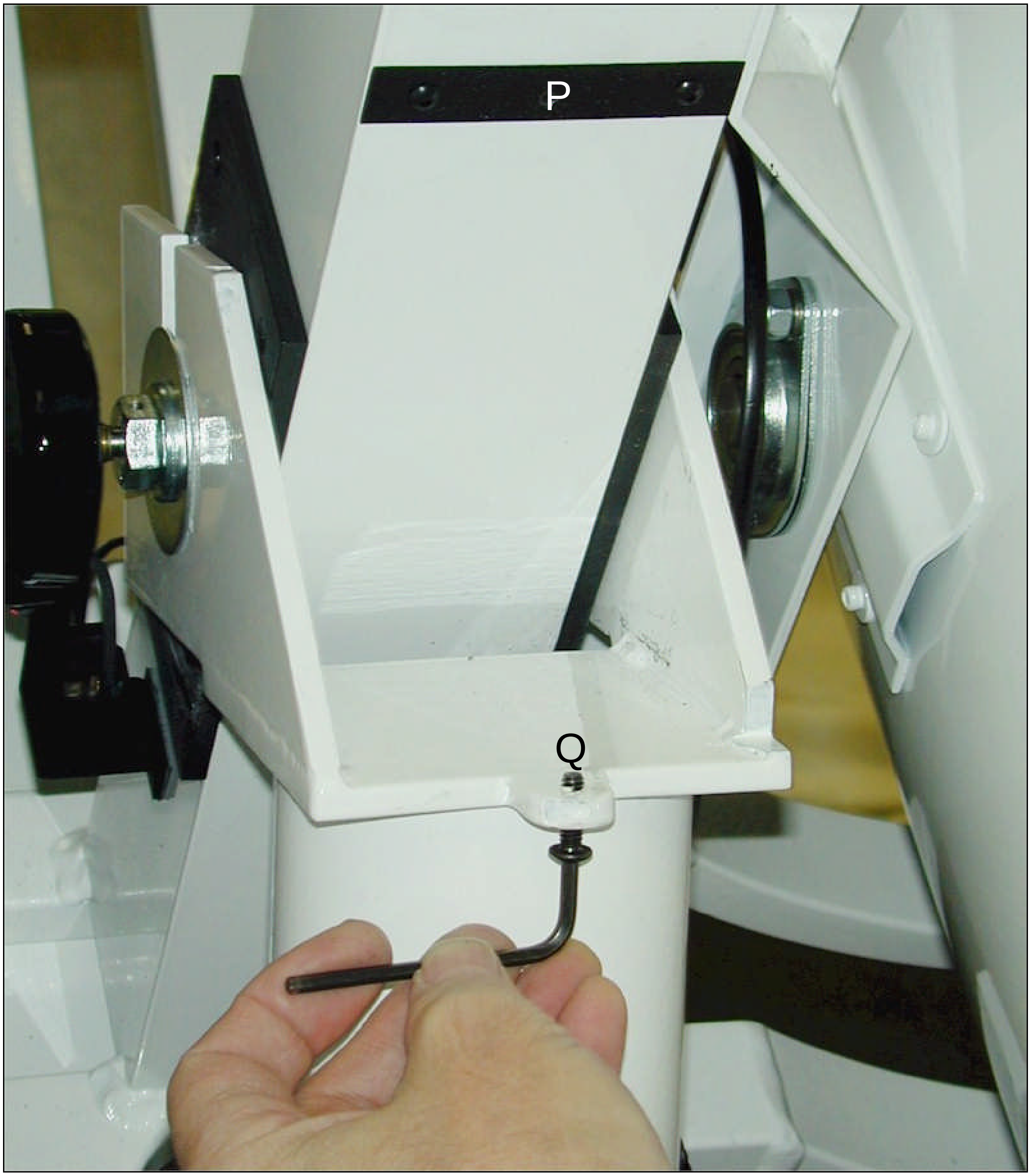


Figure 13

Most computer guiding systems have an initial alignment position that is either vertical or horizontal with respect to the base. The RB16 uses a vertical initialization (see Figure 13). When you slowly push the scope to vertical it will stop when the plate (P) touches the screw (Q). **Be careful not to bang the scope against this stop as it could bend and corrupt the position.** This screw has been set at the factory for the scope to be at vertical upon contact. If you ever feel that this adjustment is in error, you can change it using an Allen wrench as shown.

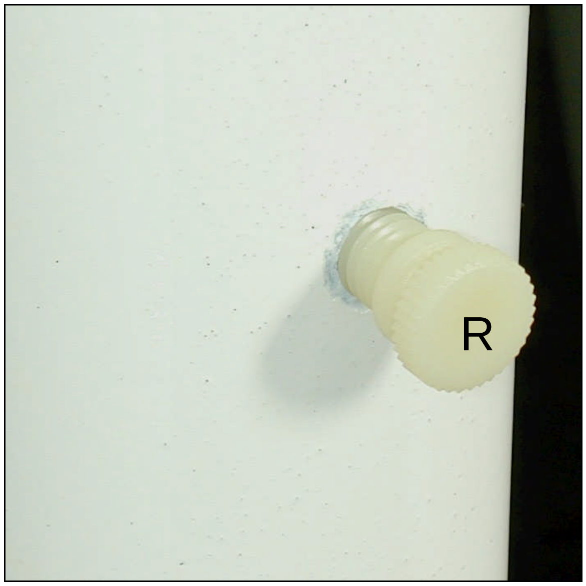


Figure 14

There is a nylon thumbscrew (R) in the pier (Figure 14). Tightening this thumbscrew will increase the resistance to azimuth movement of the telescope.

Figure 15

If you have a shroud, it is already connected to the top snaps. Pull the shroud down to connect it to the bottom snaps on the tub as seen in Figure 15. This will keep it out of the light path.

The tow handle for the Handlebar and Wheels is inserted into the bottom frame as shown in Figure 16 and secured with a T- handle thumbscrew.

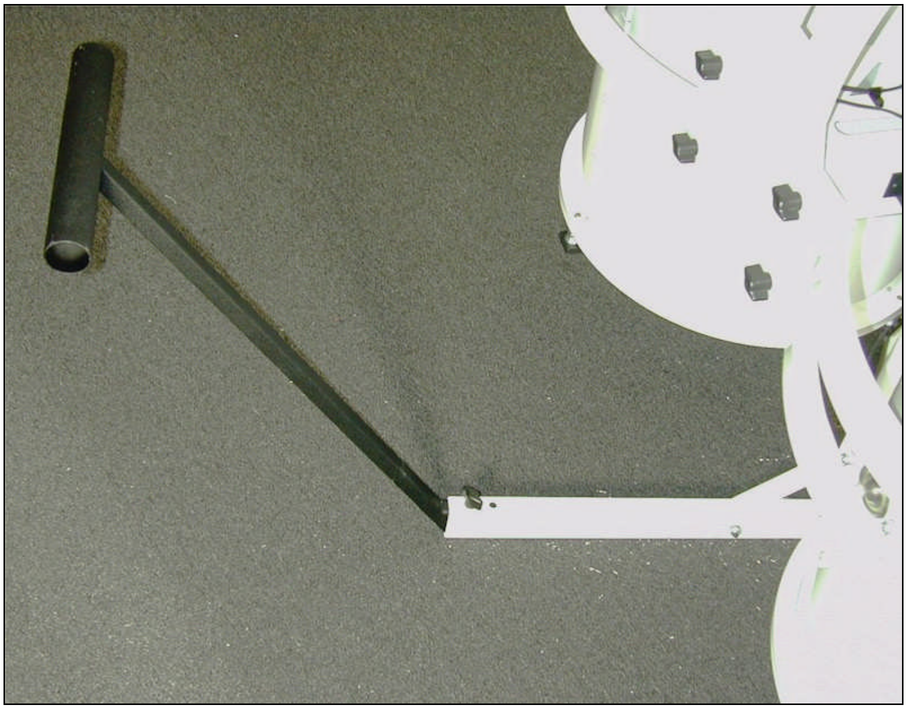


Figure 16

The NGC-superMAX (Argo Navis) computer holder is attached as shown in Figure 17.

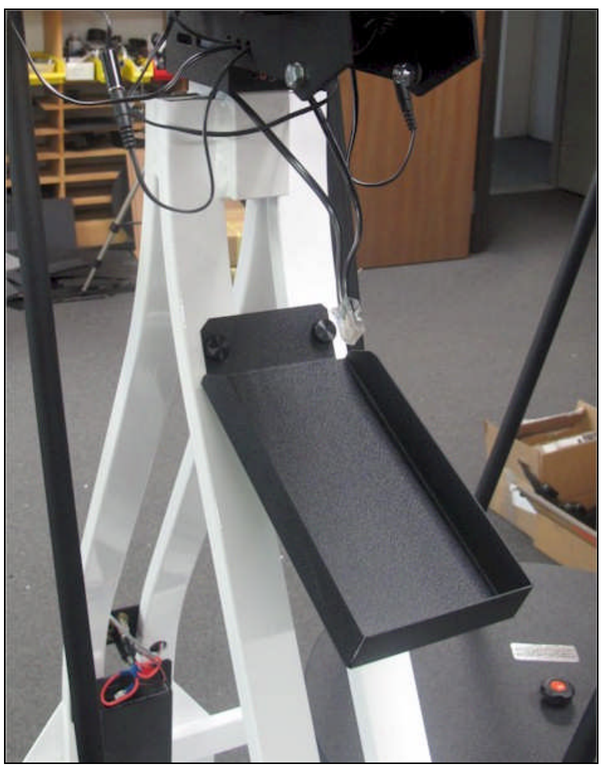


Figure 17

Figure 18

The NGC-MAX computer is placed on the guiding handlebar above the focus buttons as shown in Figure 18.

Collimation and Image Convergence

Because this is a twin-Newtonian telescope system there are some special relationships that must be remembered to keep it both **collimated** and **converged** (these two terms are *not* the same thing). Collimating each optical tube is done as normal with a laser and/or Cheshire eyepiece like any Newtonian telescope. Converging the images is done with the L/R and U/D motors. Changes to the collimation of either the primary mirror or the secondary mirror will result in changes to the convergence of the images. Some slight tweaking of the primary mirror can also be done to help with the convergence of the two images.

If the two eyepieces are not parallel to each other (Figure 19) the two images will appear to be split vertically. You can tell if they are misaligned by looking in the focusers without the eyepieces in. The two secondary stalks (and secondary mirrors) should be seen directly on top of each other and not split into two separate pieces (Figure 20). The eyepieces should also remain parallel with the optical tubes (Figure 21).

Parallel Eyepieces　　Not Correct

Figure 19

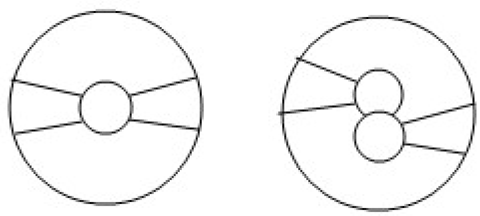


Figure 20

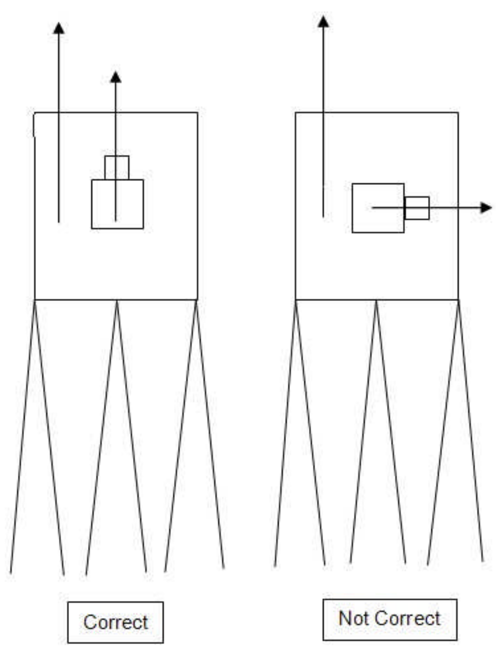


Figure 21

During the course of using the eye-spacing motors, they may become unsynchronized in their positions and need to be reset. It will appear obvious that even when the two eyepieces are in focus they will be sitting at different heights. Every effort is made to keep the eyepieces centered between the two optical tubes and even in height but occasionally they may be slightly off. In the example below (Figure 22), both images are in focus but the left eyepiece is lower than the one on the right. You can raise the left eyepiece (or focus point) by pushing the focuser drawtube inwards towards the secondary mirror (A), roughly the same distance as the difference in eyepiece height (B). This will move the focus point upwards (C) so that you will have to raise the focuser upwards so the eyepiece is at the same height as the other one. You will then have to reset the eye spacing because moving the drawtube inwards has increased the distance between the two eyepieces. After resetting the eye spacing you can than refocus each eyepiece.

Since eye spacing and focus are done with motors, this is easier that it sounds. The reverse is also true. If you need to lower the eyepiece, pull the drawtube out away from the secondary mirror and the focuser will have to be lowered. This can be done by unplugging one of the eye-spacing motors and running the other one by itself. You can also compensate for this by moving the primary mirror slightly forwards or backwards depending on where the eyepiece needs to be. If you move the primary mirror in this fashion, care must be taken to move all three collimation screws by the same distance so it will stay in collimation.

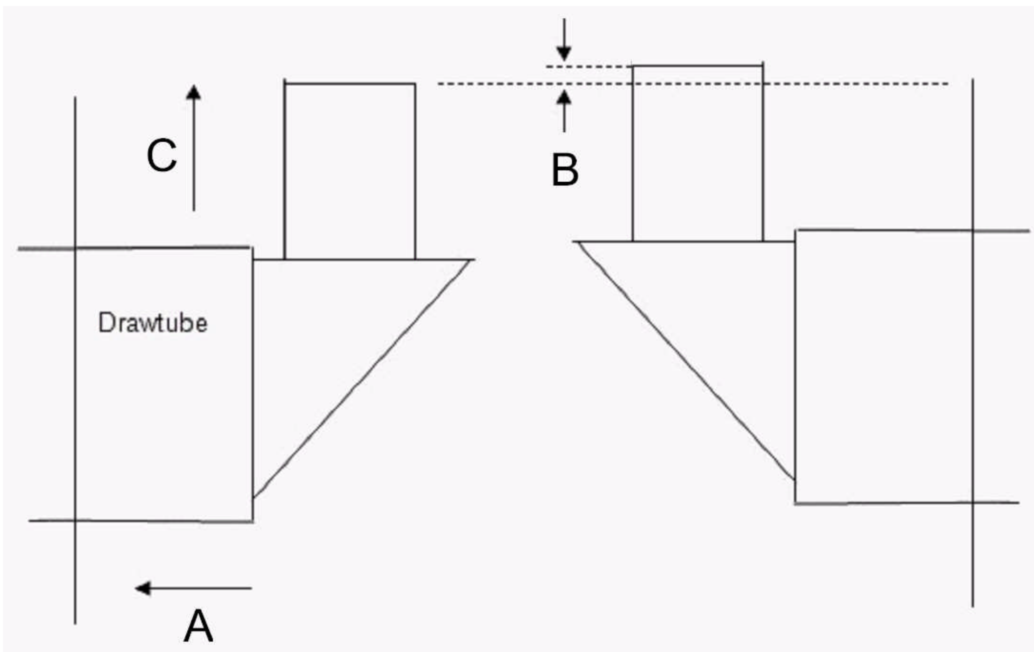


Figure 22

Using the RB-14.5 and RB-16 Motors

Converging the Optical Tube Images

When you look through the RB-14.5 or RB-16 you may see that the images are not converged. As shown in Figure 23, you should **always move the images to a vertical alignment first** (one star above the other in the eyepieces), using the L/R button, and then move the images together with the U/D button. The best way to do this is to look back and forth between the eyepiece view and a relaxed unaided view. The human eye will tend to converge the images by itself if you try to do this with a horizontal alignment first. Fight the urge to reverse steps one and two and do the vertical alignment first so you won't be looking at your image with crossed eyes, which will cause eye strain.

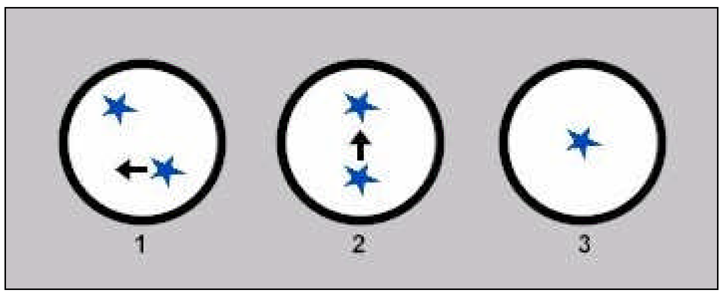


Figure 23
Steps in Aligning the Optical Tubes

Maintaining the RB-14.5 and RB-16

The following maintenance routines will preserve the accuracy and reliability of your telescope and help prolong its life.

Cleaning Front-Surface Mirrors

<u>Never wipe a dry mirror with a lens tissue or other material, as this will scratch the surface coating.</u>

Follow these steps to properly clean the RB mirrors and preserve their life. Do not clean the mirrors too frequently. If properly handled and protected from dirt, the mirrors should require cleaning only once or twice a year. The mirrors can be cleaned without removing them from the cell, however the cells should dry completely before they are returned to the binocular.

First, gather the following materials:

- Soft, absorbent cotton balls.
  Be sure the cotton is 100% pure (such as Red Cross). Other cottons may contain wood pulp or other foreign matter that will scratch the mirror surfaces.
- Mild detergent (such as Dawn)
- Distilled water
- Acetone, ethanol or compressed air in a can.
  Observe all cautions and warnings on the labels. Acetone and its vapors are harmful. Rubber gloves are recommended to prevent absorption of acetone through the skin. Acetone is available at most paint or hardware stores. (If acetone is used, remove the central dots prior to cleaning, as the acetone will dissolve the adhesive causing it to run and stain the mirror surface. The dots are required for collimation. Replace them after cleaning.) Ethanol—also known as ethyl alcohol, 200-proof alcohol or drinking alcohol—may be substituted for acetone. <u>Do not use rubbing alcohol on your mirror surface</u>, as it adversely reacts to the aluminized surface and can ruin the mirror coating over time. Compressed air can also be used as long as you are careful to keep any propellant from being discharged onto the mirror.
- A tub large enough to allow the mirror to be fully immersed.

Use the Following Procedure for Each Mirror
Fill the tub with a solution of lukewarm distilled water and mild soap. Rinse the mirror by pouring distilled water over the mirror, flooding the surface to remove loose dirt and dust—if large particles are not removed they will scratch the mirror during the cleaning process. Next, immerse the mirror in the tub and allow it to soak for 1.5 to 2 hours. Let the liquid do the work as much as possible to minimize contact with the mirror surface. Soaking overnight with <u>pure distilled water</u> will loosen almost any particles and will not hurt the glass or mirror surface.

After the mirror soaks, raise it to within 1cm (1/2-inch) of the water's surface and use the cotton balls to remove any remaining particles. It is best to roll the cotton ball over the mirror's surface—with the leading edge rolling upward—allowing the particles to be lifted away. Replace the cotton ball after one rotation, thus preventing the dirtied cotton from contacting the mirror surface. Do not apply pressure to the cotton—simply allow the weight of the wet cotton to do the work. Clean the entire surface of the mirror in this fashion. You may find it easiest to work from the mirror's center, spiraling outward.

Lift the mirror out of the tub and place it at an angle to drain as you rinse. Rinse with distilled water to remove all soap solution from the mirror surface.

Finally, before the mirror can dry, rinse again with acetone or ethanol or use compressed air to chase the water beads from the surface. Acetone and ethanol will evaporate to leave a pristine surface. (If necessary, remove any remaining water spots by dabbing them lightly with clean, dry Red Cross cotton. Dab, but do not wipe.)

If you have not removed the mirror from the mirror cell, be sure to allow the cell to dry completely before returning it to the telescope. A blow dryer can help speed the drying process.

Collimating a Newtonian

Collimating is the process of aligning the optical components of the telescope for optimum performance. When a telescope is in need of collimating, you are likely to note that a star in the center of the eyepiece field will not focus precisely and will appear to be non-circular (elliptical or fan-shaped) when the image is out of focus.

In a Newtonian reflector such as the optical tubes included in the Reverse Binoculars, there are three components to align: the eyepiece, the secondary mirror, and the primary mirror. All three must be accurately aligned with respect to each other. Information in this section will enable the RB owner to align the secondary and primary mirrors of each optical tube. See "Using the RB-14.5 and RB-16 Motors" (page 19) for information on focuser and optical tube alignments.

Under normal conditions you should only need to collimate the primary mirrors, so you can skip the first step below. Remember that changes in collimation will require realignment of the optical tubes.

The following instructions include illustrations for a Newtonian with a spider-type secondary mirror support. The RB-14.5 or RB-16 includes a double-stalk secondary mirror holder, so keep this in mind when comparing what you see with the examples.

The First Step in Collimating—Use of the Sight-Tube

A sight-tube with accurate crosshairs is essential in the first step of collimating a Newtonian reflector. The sight-tube is used to achieve accurate placement of the secondary.

First, adjust axial placement of the secondary by placing the sight-tube in the focuser and moving it in or out until the outside edge of the secondary mirror is just inside the bottom edge or rim of the sight-tube. The two circular images should be concentric. If the secondary is high or low, loosen the retaining screw and nut combination and move the secondary axially (toward or away from the primary) until concentricity is achieved.

Next, adjust the rotation of the secondary by rotating left or right until the reflection of the primary mirror as seen in the secondary mirror is perfectly centered left to right. Gently tighten the secondary center screw.

Finally, adjust the tilt by loosening one or two of the three screws on top of the secondary mirror cell, and carefully tightening the opposite one or two. (If you loosen one screw, you must tighten two; if you loosen two, you must tighten one.) The goal is to adjust the tilt of the secondary such that the bull's-eye, or target, on the primary mirror appears centered in the crosshairs of the sight-tube. When the secondary is properly adjusted, you will see the following (as described from the outside of the field of view toward the center):

- The rim of the sight-tube.
- The outside edge of the secondary mirror, concentric with the rim of the sight-tube all the way round.
- The reflection of the primary mirror perfectly centered in the secondary.
- The bull's-eye of the primary centered in the crosshairs of the sight-tube.

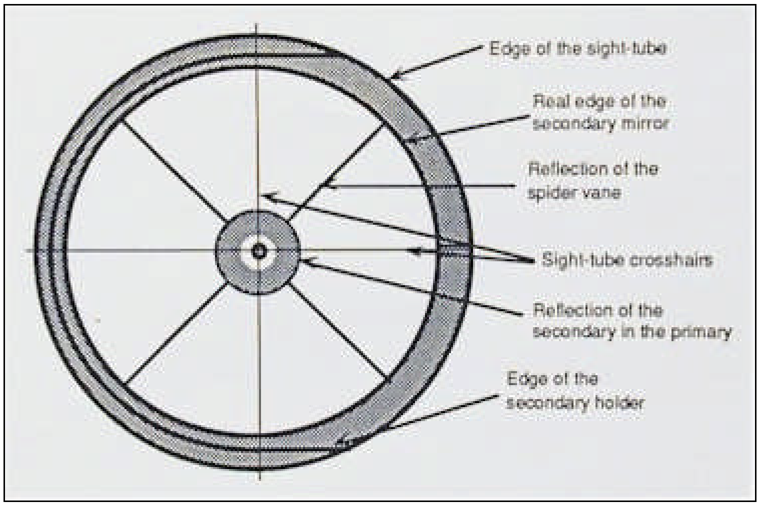


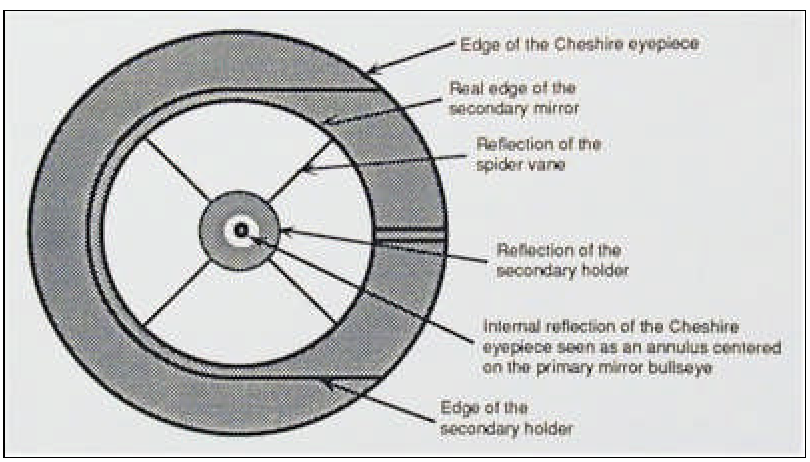
Image visible in the sight-tube

If the view does not match this description and illustration, then repeat the three adjustment steps until the view is correct.

The Second Step in Collimating—Use of the Cheshire Eyepiece
A Cheshire eyepiece is extremely useful for the next step in collimating, although the auto-collimator or star test can accomplish the same thing. Once the secondary mirror is adjusted by means of the sight-tube, insert the Cheshire eyepiece in the focuser. Do not push it all the way: the cutaway in the eyepiece must be exposed to a light source. (A red flashlight works well in the field at night.)

If you look through the eyepiece you will see the following (aside from the bull's-eye on the primary mirror):

- The reflection of the primary mirror in the diagonal.
- A generally dark field.
- A brightly lit annulus, or ring, in the center of the field.
- A dark spot, or bull's-eye, in the center of the annulus.



Detail of the image visible in the Cheshire eyepiece

Your goal is to bring the bull's-eye of the primary mirror into alignment with the central dot imaged by the Cheshire. Accomplish this by adjusting the three collimating bolts of the primary mirror cell. Adjust in small increments while checking the alignment. First, loosen the center brass nut to make it possible to turn the collimating bolts. (Tighten the brass nut again when collimation is complete.) Continue to make adjustments until the bull's-eye of the primary mirror appears within the central dot of the annulus. When you have achieved this, the telescope is collimated. (See the following illustration.)

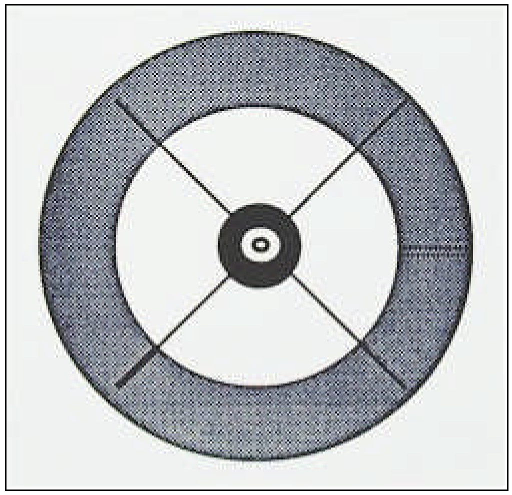


Image visible in Cheshire eyepiece when the system is properly collimated

If, after repeated adjustments you still cannot adjust the primary mirror into collimation, the problem is likely to be misalignment of the secondary. Check the secondary to determine whether it must be raised, lowered, rotated or tilted. While this process may require several repetitions the first few times, you will find that, with practice, you can quickly determine what adjustments to make to the secondary mirror by observing the location of the bull's-eye with respect to the central dot. Once you are familiar with the process, fine-tuning the collimation can be accomplished in just a few minutes.

Use of the Auto-Collimator

An auto-collimator eyepiece is available from Tectron, along with three tools and an instruction booklet. By following instructions provided with the auto-collimator, you can make final, ever-so-slight adjustments to the secondary mirror, if necessary. The auto-collimator is not intended, however, for use in making adjustments to the primary mirror. To adjust the primary mirror, follow the steps outlined in the section above, "Use of the Cheshire Eyepiece."

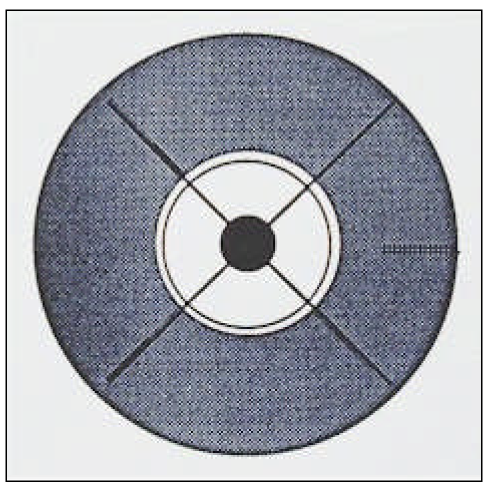


Image seen in the auto-collimator eyepiece when the system is properly collimated

General Maintenance

Unless you are using the instrument in extremely dirty condition or without the covers you should not need to clean anything inside (other than the mirrors) except possibly the threads on the focus motor lead screws. If it becomes necessary, clean the threads then add a small amount of grease.