ASTRO-TECH AT10RCT from Astronomy Technologies

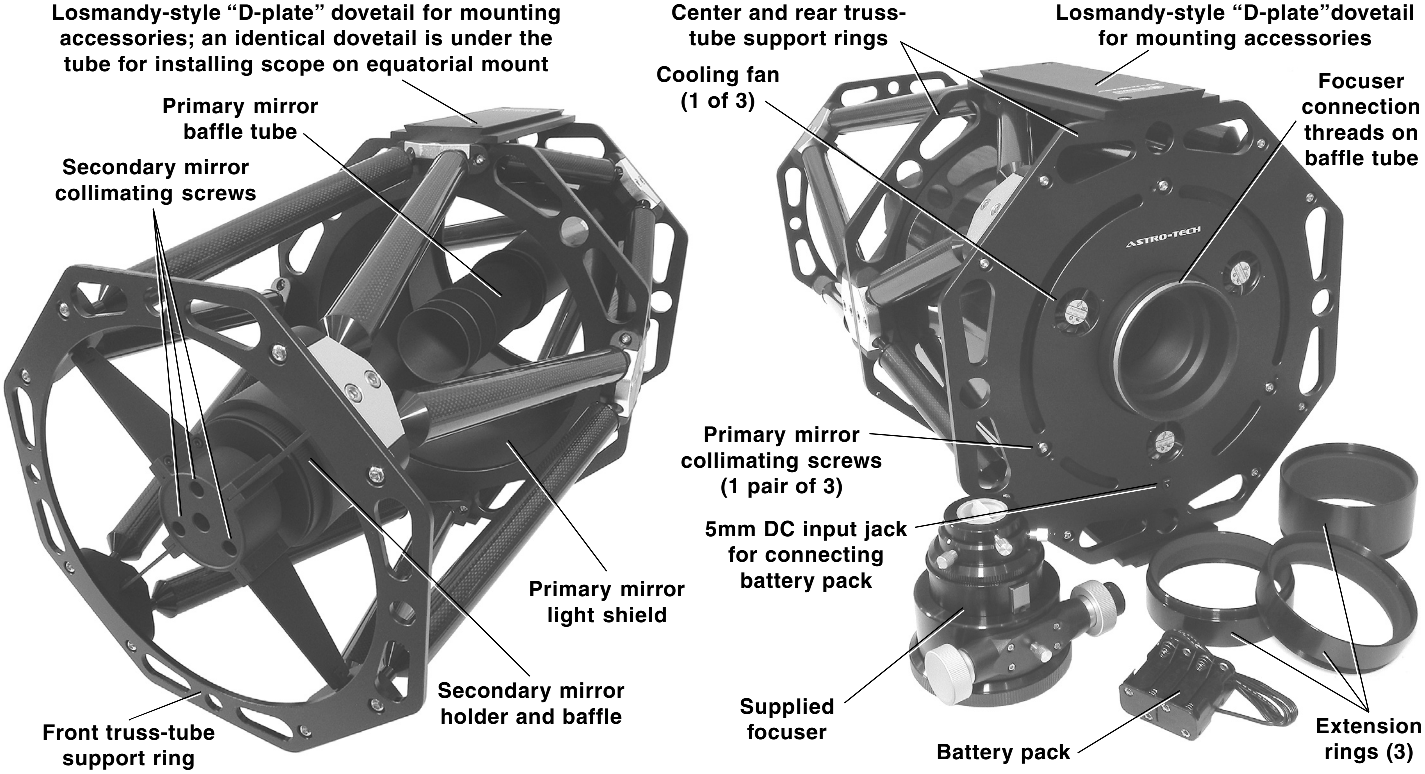
Thank you for choosing the **Astro-Tech AT10RCT** 10" f/8 Ritchey-Chrétien Serrurier truss reflector.

Your AT10RCT is designed specifically for exceptional coma-free imaging using DSLR cameras and large-format CCD cameras having up to a 35mm equivalent chip size. Because of its long back focus, it is particularly good with systems involving long imaging equipment chains (combining a camera, filter wheel, temperature-compensating robo-focuser, etc.)

This instruction sheet will provide you with information on how to get the most out of your new Ritchey-Chrétien reflector, and how to properly maintain your telescope so it can give you a lifetime of high quality imaging enjoyment.

Please familiarize yourself with your scope's parts and functions before operating it for the first time.

PARTS OF THE AT10RCT



Focuser: The AT10RCT comes with a dual-speed linear bearing 3" Crayford focuser for use with light imaging trains (such as a DSLR body only). However, a very heavy multi-component imaging train would probably require an upgrade to a rack-and-pinion focuser to support its extra weight. Alternatively, you may already have a premium focuser you use on another scope that you would like to use for imaging, or you may want to install a robo-focus for use at a remote observatory.

The supplied AT10RCT focuser can be unthreaded from the rear cell, allowing you to substitute your own focuser. One popular premium focuser used by many astrophotographers is the dual-speed 3" Feather Touch #3015 rack and pinion. Focusers with a 1.5" drawtube travel, such as the Feather Touch #3015, are recommended for use with the AT10RCT.

The rear cell of the AT10RCT has a male 117mm x 1mm pitch threaded port for attaching a focuser. However, the standard #3015 Feather Touch focuser has a 109mm female threaded collar for connection to a scope. Feather Touch has designed a special version of the #3015 for the AT10RCT (their part #FTF3015B-A) that substitutes a #M117x1 tube adapter for the usual 109mm threaded collar of the #3015. The #M117x1 adapter threads onto the AT10RCT rear cell and the #3015 focuser slips into the adapter, where it is held in place by three large Delrin-tipped brass retaining knobs.

The #M117x1 adapter is available separately as Feather Touch part #A30-1903-40 for those who may want to use their existing standard 109mm threaded #3015 focuser on the AT10RCT. For focusers other than Feather Touch, such as a MoonLite, contact your telescope dealer or the focuser manufacturer for the availability of an adapter to fit their focuser to the 117mm x 1mm male port on the rear of the scope.

To fine-tune the 233mm back focus of the AT10RCT to the requirements of your focuser and imaging equipment train, three threaded extension rings (one 50mm in length, and two 25mm) are provided. These thread singly or in combination between the 117mm threaded port on the rear cell of the AT10RCT and the 117mm adapter that holds the focuser of your choice. The extension rings provide a flex-free solid metal extension that changes the distance between your chosen focuser and the rear cell. This lets you accommodate the varying back-focus requirements of DSLR-type camera imaging versus long equipment train CCD imaging.

Mounting Your AT10RCT: Two 9.8" Losmandy-style "D-plate" dovetail plates are bolted to the middle and rear truss-tube support rings. These let you install the AT10RCT on an equatorial mount, as well as mount optional accessories (such as a photoguide scope) on top of the AT10RCT. Because of the 33.5-pound (15.2 kg) weight of the AT10RCT, plus the weight of your focuser and camera equipment, installing the AT10RCT on a high quality German equatorial mount with a minimum payload capacity of 45 pounds *or greater* is essential. Such mounts include models from Celestron, iOptron, Losmandy, Software Bisque, and Astro-Physics, among others.

The Rear Cell/Truss-Tube Support Ring of Your AT10RCT: The illustration on the first page shows the rear cell (truss-tube support ring) of the AT10RCT with the supplied focuser and extension rings that are installed between the focuser and rear cell as needed.

Visible are the three high speed/low vibration 12VDC cooling fans that help get your AT10RCT down to ambient temperature more quickly. These pull ambient air in through the rear cell, blowing it across the back of the mirror in its separate open cell and carrying the heat from the mirror up to the front of the light shield where it is quickly exhausted into the open air.

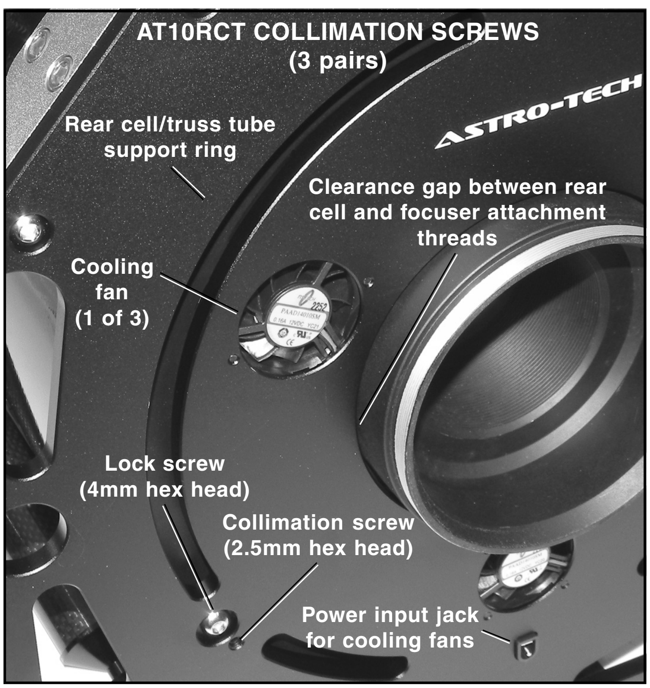
The standard equipment battery pack holds eight user-supplied AA batteries to power the cooling fans. It has a 5mm female pin jack on a 5' cord for connection to the scope. The input jack is visible at the 6 o'clock position under the bottom cooling fan on the rear cell in the illustration on page 1.

Alternatively, you may power the fans using any 12VDC power supply having a 5mm female pin jack, such as those on the 12VDC rechargeable battery packs from Celestron and others.

Also visible in the rear cell illustration are the three pairs of collimating screws for collimating the primary mirror and its attached baffle tube.

Collimation Screws: The primary mirror is mounted on a cell positioned in front of the rear cell/truss-tube support ring. A combined focuser mounting and baffle tube collar is machined into the mirror cell. The baffle tube portion of the collar passes forward through the Cassegrain focus perforation in the center of the primary mirror. This precisely centers the mirror in the cell and forms a base for attaching the baffle tube, which threads onto this collar.

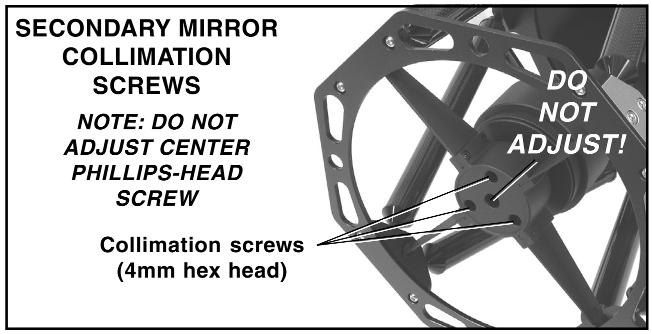
The focuser attachment portion of the focuser/baffle tube collar extends back through the center hole in the rear cell/truss-tube support ring. The focuser collar terminates in 117mm x 1mm male threads used to attach a focuser. The collar passes through an opening in the rear cell/truss support ring without touching the ring itself, as shown in the illustration in the first column of this page. This allows the primary mirror/baffle tube/focuser attachment collar assembly to form a single optical axis that can move independently of the rear cell/truss-tube support ring during collimation of the primary mirror.



There are three pairs of primary mirror collimation screws in the truss tube support ring as seen in the illustration in the first column. The smaller black recessed screws are the collimating screws. A user-supplied 2.5mm hex head wrench is needed to adjust the collimating screws.

The larger silver screws are the locking screws that hold the mirror assembly firmly in place once the primary has been collimated. A user-supplied 4mm hex head wrench is needed to adjust the locking screws.

Secondary Mirror Collimation Screws: These are the three black recessed screws in the secondary mirror holder. A user-supplied 4mm hex-head wrench is needed to adjust these.



Caution: Do not adjust the recessed Phillips-head screw in the center of the secondary holder, as this will change the primary to secondary mirror spacing and degrade image performance.

Do not disassemble your scope for any reason, including cleaning the mirrors. A small amount of dust and particulates on the mirror surfaces will not affect performance. The open structure of the Serrurier truss will allow you access to the mirrors for minor dusting and cleaning if needed. This telescope does not contain user-serviceable parts and disassembly of the components will void the warranty.

Collimating Your AT10RCT: Your Astro-Tech AT10RCT was collimated at the factory before being shipped. Nevertheless, rough treatment in transit could potentially knock the secondary mirror out of collimation, and rough and bumpy roads during transit to a dark sky observing site might require occasional re-adjustment. The optical axis of the primary mirror and baffle tube assembly is less likely to be knocked out of collimation, but is capable of being collimated if needed.

The focuser on AT10RCT threads directly onto the rear cell of the mirror cell/baffle tube assembly. Machining tolerances in the various components can sometimes lead to a minor tilt in the alignment of the focuser and camera in relation to the primary mirror/baffle tube optical path. This is rarely visible in images taken with an APS-C size imaging sensor (up to an approximately 23mm diagonal).

However, with large format 35mm-class DSLR and CCD sensors, image sharpness in the corners of your images will be improved if your camera is precisely aligned with the scope's optical path.

An optional focuser collimation ring (Astro-Tech #FCR1012) allows you to do just such a precise alignment. It lets you align your focuser/camera combination to the scope's optical path independently of the mirror/baffle tube alignment.

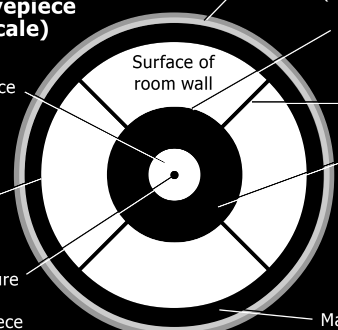
The focuser collimation ring consists of two spring-loaded rings with push/pull collimating screws that let you tilt the rings slightly in relation to each other and then lock them firmly in place. The collimation ring fits between the focuser attachment threads and the focuser to let you adjust the tilt of the collimation ring to zero out any tilt in your focuser during final scope collimation.

The telescope side of the collimation ring has M117 x 1 female threads that connect to the focuser attachment threads of your scope. The camera side of the ring has M117 x 1 male threads for attaching your focuser. The optional collimation ring takes up only 15mm of back focus.

Preliminary Collimation Check: You can do an accurate collimation of both mirrors indoors before performing a more rigorous star test for a final tweaking in the field. You will need a Cheshire eyepiece to do this collimation check.

Set up your scope in a well-lit room with the telescope on its side and pointed horizontally at a white (or light colored) wall. Insert the Cheshire eyepiece fully into the focuser using a 1.25" eyepiece adapter. An optional Glatter "Parallizer" 2" to 1.25" eyepiece adapter will assure that the Cheshire eyepiece is exactly parallel to the optical axis of the focuser. Lock the focuser drawtube firmly in place. Make sure there is a light source directed at the 45° cutout in the side of the Cheshire.

Figure 1: View through a Cheshire eyepiece (not to scale)



Look through the Cheshire eyepiece. You will see a small black dot within a centrally-located bright circle as seen in Figure 1, above. The central black dot is the viewing aperture in the center of the Cheshire eyepiece. The bright circle around the central dot is the 45° reflective surface of the Cheshire eyepiece and the larger black circle surrounding that is a reflection of the interior of the scope's baffle tube and rear cell in the secondary mirror. Your room wall and the interior of the optical tube form the background.

The ring of light around the entire Cheshire field, as shown in Figure 1, is the end of the focuser drawtube (the optical axis of the scope). You can disregard this for the time being. We will discuss it later, when checking the primary mirror collimation.

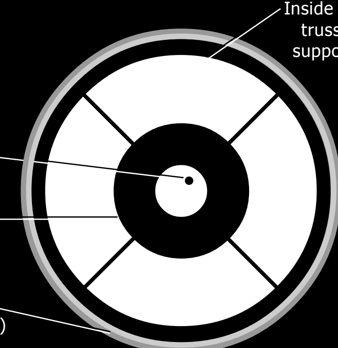
If the central black dot (the viewing aperture of the eyepiece) appears centered in the circular reflective surface of the Cheshire eyepiece as shown above, no further significant adjustment of the secondary mirror will be necessary.

Secondary Mirror Collimation: However, if the black dot of the viewing aperture appears off-center as in Figure 2, at the top of the next column, adjust the three secondary mirror collimation screws until the viewing aperture is centered as closely as possible in the Cheshire's circular reflective surface.

A user-supplied 4mm hex key is required to collimate the secondary mirror. Adjust only the three hex head screws around the perimeter of the holder, as shown in the Page 2 illustration. ***Do not adjust the central recessed Phillips-head screw in the secondary holder. This will change the precise mirror spacing required and degrade image performance.***

As you adjust each of these screws you will need to make equal counter-adjustments to the other two. In other words, as you tighten one screw you will need to loosen, by an equal amount, the other two. The opposite is also true. If you loosen a screw, the two opposing screws should be tightened. When

Figure 2: Secondary mirror out of collimation (not to scale)



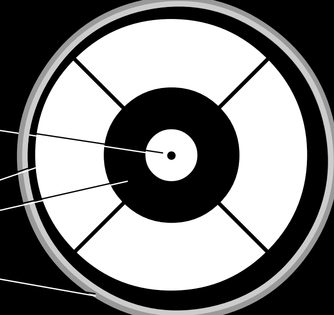
the process is complete you should have equal tension on all three screws.

Only minor adjustments should be required to fine-tune the collimation. Adjust the screws no more than an eighth of a turn or less at a time. This will help prevent accidently putting the optics grossly out of collimation. The force vector diagram on the next page will show you how different adjustments affect the tilt of the secondary mirror.

The correct alignment of the secondary mirror is critical in determining if the optical axis (primary mirror) requires alignment. Be certain you have properly aligned the secondary mirror before proceeding to the next step of adjusting the optical axis collimation, using the primary mirror collimation screws shown in the illustration on the previous page.

Optical Axis (Primary Mirror) Collimation: As mentioned on the previous page, the optical axis of the scope (the primary mirror/baffle tube assembly) will rarely need collimation. If the optical axis does get knocked out of collimation, however, the image through the Cheshire eyepiece will appear to be shifted to one side within the light ring formed by the end of the focuser drawtube, as shown in Figure 3 below.

Figure 3: Optical axis out of collimation (not to scale)



If properly collimated, all of the light and dark circles will be concentric, as shown in Figure 1 on this page.

Adjusting the optical axis will require a user-supplied 4mm hex key. There are three pairs of "push-pull" hex-head screws on the rear cell of the optical tube, as shown in the illustration on page 1 and in the close-up illustration of the collimation screws on page 2. These must be adjusted in tandem. As you loosen one, tighten the other in each pair to adjust the tilt of the optical axis in relation to the secondary mirror. This procedure will require only micro-adjustments, if any. When properly aligned, you will see a concentric outer white circle around the perimeter of your view through the Cheshire eyepiece and all circular light and dark elements will be concentric.

Once you have collimated the optical axis, recheck the secondary mirror collimation and tweak as necessary, then confirm the optical axis collimation one last time. Tweak the focuser collimation if needed using an optional #FCR1012 collimating ring.

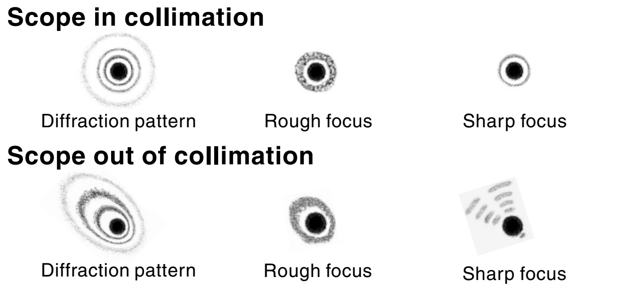
Star Testing: For optimum imaging performance, perform a star test to confirm the accuracy of your collimation. The star test relies on your eye and an out of focus star for collimation, rather than a Cheshire eyepiece. Seeing conditions will affect your results, so a star test is often somewhat more difficult than collimating indoors.

Install all extension rings between the scope's rear cell and the focuser. Using a 1.25" accessory adapter, insert an eyepiece directly into the focuser drawtube and visually center and focus on a bright star at a reasonably high magnification. An optional Glatter "Parallizer" 2" to 1.25" eyepiece adapter will assure that the eyepiece is exactly parallel to the optical axis of the focuser.

Do not use a star diagonal in the system and be certain that the focuser tension and drawtube lock knobs have been tightened firmly after focusing. Choose a star close to the zenith rather than near the horizon to minimize atmospheric distortions.

The diagram below illustrates the appearance of collimated (top) and out of collimation (bottom) images of the star being examined. The top left image is the diffraction pattern in a collimated scope. The center and right-hand images show what the star looks like when roughly focused and sharply focused. The bottom row of images shows the same sequence through an out-of-collimation scope.

APPEARANCE OF A STAR DURING COLLIMATION



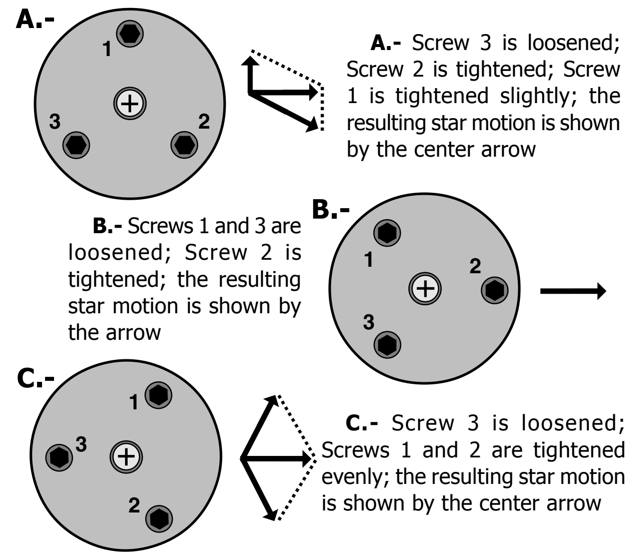
Patterns have been exaggerated for clarity

If you need to tweak the collimation, begin by placing a bright star in the center of a low to medium power eyepiece field (again without using a star diagonal). Defocus the image until it is about the apparent size of a dime or nickel held at arm's length. This will show the diffraction pattern, which should look like a bull's-eye with the circular shadow of the secondary mirror holder in the center, as shown in the illustration above. If the shadow of the secondary is not precisely in the center of the diffraction rings, adjust the collimating screws to tilt the secondary mirror until the shadow of the secondary is centered in the diffraction pattern and the diffraction rings are concentric.

Always make your adjustments to the collimating screws in tiny increments, only a fraction of a turn at a time. The image of the secondary shadow will move in the direction of the collimating screw being tightened. If the secondary shadow needs to be shifted in a direction between two screws, those two must be tightened to make the image shift in that direction, while the single screw on the opposite side should be loosened. As each adjustment is made, the secondary shadow will move off center. Recenter the star's image in the field before making the next adjustment. Keep the star precisely centered in your field of view at each stage of the collimation process, as this is critical to avoid false negatives.

Refer to the diagrams below, which show the direction the star image will move as you loosen and tighten different combinations of collimating screws. In all cases, we assume that the star image needs to shift in the 3 o'clock direction. The screws that need to be adjusted depend on the orientation of the three collimating screws in relation to the desired star movement direction.

FORCE VECTOR DIAGRAMS FOR VARIOUS SECONDARY MIRROR SCREW ADJUSTMENTS



Repeat the collimation procedure several times, using successively higher power eyepieces, until you are sure the collimation is exact. Finally, after the final adjustments have been made, make sure that all of the collimating screws are snugged down tightly and evenly to ensure that the collimation will hold for many trips out into the field.

Astro-Tech AT10RCT Carbon Fiber Serrurier Truss Ritchey-Chrétien Reflector Specifications

Aperture .... 250mm (10")
Focal Length 2000mm
Focal Ratio f/8
Optical Type .... true Ritchey-Chrétien dual hyperbolic mirror reflector
Mirrors .... low thermal expansion quartz, 99% reflectivity dielectric multicoatings
Secondary Mirror Holder Obstruction .... 111mm (44.4% by diameter, 19.7% by area)
Back Focus .... 9.17" (233mm) from end of focuser attachment
Optical Tube ... carbon-fiber Serrurier truss; all CNC-machined stainless steel and aluminum ball-and-socket hardware, aluminum support rings, secondary mirror holder and spider; thin rolled steel primary mirror light baffle
Center/Rear Support Rings Diameter .... 15.75" (400mm)
Front Support Ring Diameter .... 13.38" (340mm)
Focuser .... 3" dual speed Crayford with 2" and 1.25" adapter
Focuser Port .... 117mm dia. x 1mm pitch male thread
Extension Rings (to adjust back focus) . three; one 2" (50mm) and two 1" (25mm) in length, each with male and female 117mm x 1mm threads
Dovetails ...... two 9.8" long Losmandy-style "D-plate" dovetails
Tube Length (without focuser) .... 24.4" (1156mm)
Weight (without focuser) .... 33.5 lbs. (15.2 kg)

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