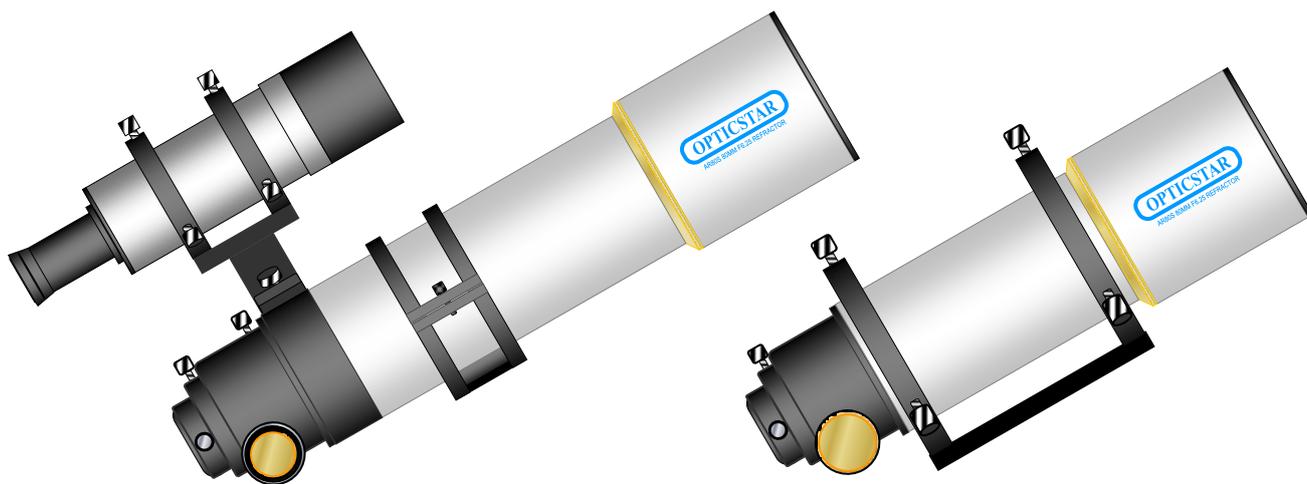


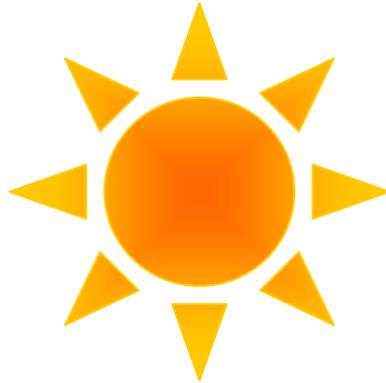
# OPTICSTAR ACHROMATIC REFRACTORS

AR80S GOLD & ARS90S GOLD Achromatic Doublet Refractor Telescopes

## Owner's Manual







**WARNING!**

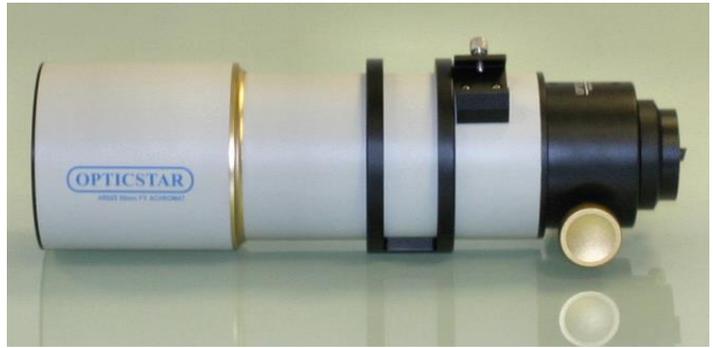
DO NOT USE THE TELESCOPE OR FINDERSCOPE TO LOOK AT OR CLOSE TO THE SUN AS THIS WILL CAUSE INSTANT AND PERMANENT DAMAGE TO YOUR EYES. CHILDREN SHOULD AT ALL TIMES BE SUPERVISED BY A RESPONSIBLE ADULT WHILE OBSERVING.

**Do not disassemble your telescope, there are no user serviceable parts inside. Disassembling or removing the lens cell will invalidate your warranty.**

## Introduction

Congratulations on the purchase of your Opticstar ARS Gold achromatic refractor. This ARS telescopes are well suited for both astronomical and terrestrial observation. Their high quality achromatic optics, solid construction and very low focal ratios of f5/f5.5 make them also ideal for deep sky imaging, for use as a guider, or as travel and spotting scopes. The

f7.5/f8.8 versions are better suited for higher magnification work including observing the Moon and the planets.



AR80S refractor with single-speed Crayford Focuser

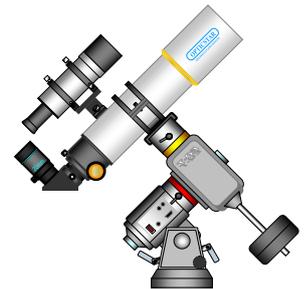
Please read through the manual to familiarise yourself with your new telescope so that you can get the best use of the equipment.

## Mounting the Telescope

The telescope can be mounted as is on any photographic tripod with a standard photographic 1/4 inch thread.

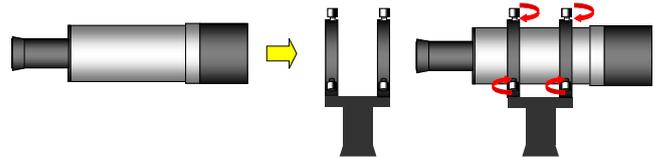
Standard tripod heads will work adequately at low to medium magnifications, a geared head with slow-motion controls is recommended for high magnifications or when fine control is required.

To mount your telescope on a dedicated telescope mount you would need the appropriate dovetail for your mount.



## Finder-scope Assembly and Alignment

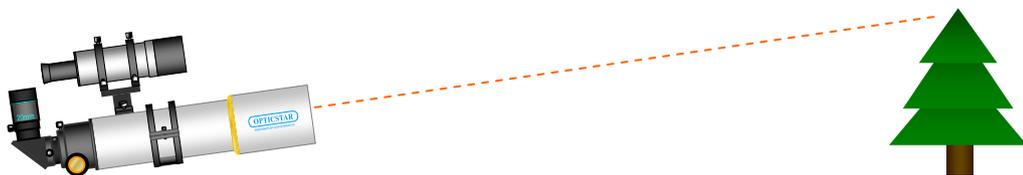
To assemble the finder-scope place the finder-scope optical tube in the supplied bracket and tighten the six silver thumbscrews enough to secure the finder-scope optical tube in place as in the picture below.



Mount the assembled finder-scope to the telescope and secure it in place. Attach the telescope to a mount/tripod.

To align the finder-scope please perform steps 1 through 9 as outlined below, we recommend that the telescope is first aligned during daytime. Please note that view would appear mirrored and/or flipped.

1. Attach the finder-scope to the telescope.
2. Mount the telescope to a photographic tripod or astronomical mount.
3. Place a low to medium power (i.e. 20mm-25mm) eyepiece in the telescope's diagonal. Secure the eyepiece in place.
4. Loosen the movement locks of your mount/tripod, this will allow the telescope to move freely.
5. Point the telescope to a distant land object (i.e. the top of a lamp post, tree or chimney). You will notice that the image will be mirrored and/or upside down, this is normal for an astronomical telescope.



6. Turn the focuser knob to bring the target in focus and centre the object in the eyepiece.
7. Re-tighten the tripod/mount movement locks so that the telescope remains stable during the finder-scope alignment procedure.
8. Look through the finder-scope.
9. Use the collimating thumb-screws on the finder-scope's bracket to align the finder-scope so that the cross-hair is precisely over the same object in the eyepiece. You only need to use the three thumb-screws on a single ring to align the finder-scope.



The finder-scope is now aligned to the main telescope. You can check and refine alignment on a night sky object like a star if required. Please note that the view will not be the right way up and views will differ depending whether a diagonal is used or not. If you do not use a diagonal you will need an extension tube to reach focus.

### Using the AR80S and A90S Gold Telescopes

If you are new to observing it is advisable to first use the telescope during daytime to learn how it operates. First mount the telescope on a tripod or telescope mount. Once the optical tube has been mounted attach the finder-scope, then attach a diagonal and low/medium power eyepiece i.e. 20mm. Make certain that all parts are secure.

Simply choose a distant target to observe like a large building or large tree. Point the telescope towards the target so that it roughly lines up with the target.

Look through the finder-scope, if you have not aligned it already this is a good time to do so before you proceed. Move the telescope until the target is visible in the finder-scope and positioned under the cross-hair.

Once the object is lined up in the finder-scope you will be able to observe the target through the telescope's eyepiece. Look through the eyepiece, then turn the focuser knob to bring the target into focus.

### Terrestrial Observation

You can use the telescope for terrestrial observation for which you need a prism diagonal, otherwise the image will appear mirrored and/or upside down. In astronomy it is not relevant if the Moon is say upside down, what is important is to capture as much light as possible and correctors take some of this valuable light away.

### Astronomical Observation

When observing at night your first target should be the Moon as it offers a wealth of detail, it is large, bright and easy to locate. Spend some time with the Moon, high magnifications will show a wealth of detail. You will see mountain ranges, craters and evidence of volcanic activity when the Moon was mainly composed of melted rock. You will need a neutral density filter to observe the Moon, a 25% transparency Moon filter is recommended but this may vary depending on the chosen magnification.

Once confident with the Moon the planets would be the next target. Planets are easy to identify as they are bright and do not twinkle unlike stars. Please note that when a planet is out of focus and it becomes very dim you may not be able to see it. Use the finder-scope to place the planet in the centre of the field of view, then look through the eyepiece and use the telescope focuser to bring the planet into focus. Planets that are easy to observe include Venus, Mars, Jupiter and Saturn. You will get the most out of the planets at higher magnifications. Even at high magnifications planets will look like small peas, they will however reveal a reasonable degree of detail to the trained eye. Jupiter will show banding and the Red Spot and you will be able to observe the Galilean Moons.

Saturn is probably the most exciting planet to observe through a telescope. While surface detail is subtle its rings are a unique site and you should be able to observe the Cassini division which appears as a black gap between the rings. Mars also known as the Red planet will reveal a reasonable amount of detail when close to Earth. Its orange colour is prominent and surface markings are visible as are the Polar caps when present. Venus can be observed early in the morning before dawn or just after sunset. Venus appears quite large in the telescope but its atmosphere will hide any surface detail.

Deep sky observation greatly depends on the prevailing sky conditions. City lights, low sky transparency and the presence of the Moon will greatly affect what you can see through the telescope. From a dark site and under favourable conditions you will be able to see several deep sky objects including star-clusters, galaxies, nebulae and comets. Such objects with the exception of stars will appear as feint clouds of matter in monochrome, human eyes are not able to pick up colour. Cameras on the other hand can reveal colour and considerable amounts of detail.

Good deep sky objects to look for with a small telescope include the Orion Nebula, the Trifid nebula, the Ring nebula, the Andromeda Galaxy and a number of star-clusters among various other objects.

## Observation Skills

In general it is easier to locate a target with a low power eyepiece i.e. 25mm. Once the target has been located centre it in the field of view before replacing the 25mm eyepiece with a high power one, i.e. 5mm.

There are many factors that will affect the quality of the image through the eyepiece, such factors include sky quality in terms of the level of light pollution, sky transparency and the presence of the Moon if you are observing deep sky objects like galaxies and nebulae. If you use an equatorial mount make certain that the telescope has been balanced and that all screws are reasonably tight.

You will always be limited by the type, size and the optics of your telescope in what you can see. However there are other important factors to consider that can substantially improve the experience. Let the optics to cool down for best results, this varies depending on the size and type of the telescope but typically an 80mm or 90mm refractor like the AR80S and AR90S will need around 15 minutes to cool down.

Please keep in mind that targets near the horizon will not look as sharp, targets near the zenith will look substantially sharper. Avoid setting your telescope on concrete; wood and grass are better as they do not release as much heat. Your line of sight should ideally not pass just over a warm house, the rising heat will substantially affect the quality of the image.

The faster f5/f5.5 focal ratios of the AR80S and AR90S scopes make them ideal for deep sky viewing and imaging or for use as guide scopes. When conditions are not favourable the maximum useful magnification for most scopes will be around 25-35 times per inch of aperture. Otherwise expect higher practical magnifications per inch of aperture under favourable conditions with good quality eyepieces. Also expect higher magnifications for the f7.5 & f8.8 models; these are better suited for planetary and Lunar observation.

Dew shields are useful as they cut stray light entering the telescope, they also protect objective lenses from dew building up on the optics. The AR80S and A90S come with a retractable dew-shield which should always be used.

## Observing the Sun

Special precautions need to be taken when observing the Sun with a telescope. A full aperture filter must be used to dramatically reduce the amount of light that enters the telescope, only use filters designed to be used for Solar observation with a telescope.

A second filter can also be used at the eyepiece (in conjunction with a full aperture Solar filter) to increase the level of surface detail i.e. Solar Continuum Filters. Such filters work well with digital cameras in particular and will reveal additional detail otherwise not visible to the human eye. Always check the integrity of any Solar filter before using it with a telescope. A hair-line scratch on a filter is enough to damage your eyesight. If in doubt seek professional advice and never point a telescope towards the Sun without a suitable Solar filter.

## Visual Accessories

Depending on what came with your telescope you may need a number of extra eyepieces which will provide a wider range of magnifications. For example high magnifications are required for the Moon, planets and planetary nebulae. Low magnifications are useful for observing extended objects and for locating targets. Ninety degree star diagonals are necessary as they make astronomical observation comfortable. For terrestrial observation forty-five degree prism diagonals are preferred, such diagonals will also offer a corrected view unlike star diagonals.

A Moon filter will be necessary to observe the Moon with almost all telescopes including the AR80S and AR90S, light pollution filters can also help by reducing sky glow and incoming light from other local light sources

## Imaging Accessories

When imaging with a camera attached to the AR80S or AR90S infra-red block, nebula (UHC) photo-visual and narrow-band filters (O3, H-alpha, S2) are recommended depending on requirements.

The ARS F5 and F5.5 are suited for wide field deep-sky imaging due to their low focal ratios, solid structures and Precision Focusers. They are well suited for deep sky imaging when coupled with DSLR cameras or cameras like the Opticstar DS616 XL TEC-cooled camera which supports long exposures in conjunction with very low noise levels.

The ARS Gold telescopes can also be used as a guide scopes for auto-guiding motorised/GOTO telescope mounts in conjunction with an appropriate guide camera and auto-guide controller. Complete auto-guide camera kits include the Opticstar AG130M CA, AG131M CA and AG131C CA. Such kits consist of a guide-camera, auto-guide controller, cables, adapters and software to auto-guide with.

## APPENDIX A

Appendix A outlines the most important aspects of a telescope in terms of its focal length and focal ratio. These values are important as they dictate magnification, exposure times when imaging and fields of view.

### Practical Magnification

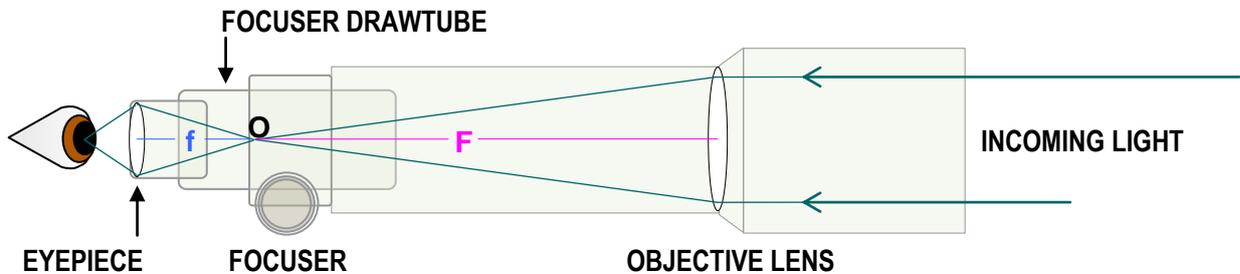
The focal length of a telescope can be calculated by multiplying the focal ratio of the telescope with its aperture i.e. an f5 refractor with 80mm of aperture will have a focal length of 400mm ( $5 \times 80 = 400$ ).

In a telescope, magnification is the number of times an object appears larger to the observer when compared to what the observer can see with the naked eye. There is no real limit to the amount of magnification possible in a telescope, but practical magnification is limited by the optical system and is normally around 30-40 times per inch, and around 50-70 times per inch of aperture for high quality apo-chromatic refractors. Experienced observers using high quality telescopes may push these figures even higher under favourable conditions.

Please keep in mind that the maximum useful magnification from a suburban yard using any telescope will be around  $\times 30 - \times 35$  per inch of aperture, this is due to light pollution (sodium lights in particular), thermal currents and other environmental factors. Expect higher magnification from dark sites and when transparency is good.

### Eyepieces and Magnification

The actual magnification capability of a telescope will vary depending on the eyepiece attached to the telescope. Magnification can be changed by simply exchanging eyepieces.



Magnification depends on two factors. The focal length of the telescope and the focal length of the eyepiece used. To calculate the magnifying power an eyepiece gives, simply divide the focal length of the eyepiece into the focal length of the telescope.

$$\text{Magnification} = \text{telescope's focal length} / \text{eyepiece's focal length} = F/f$$

For example a telescope with a focal length of 400mm and an eyepiece with a focal length of 5mm will magnify its target 80 times ( $400/5=80$ ).

Barlow lenses can be employed in conjunction with an eyepiece to increase magnification. To calculate the magnifying power an eyepiece gives in conjunction with a Barlow lens, simply divide the focal length of the eyepiece into the focal length of the telescope and multiply the result by the Barlow's magnifying power.

$$\text{Magnification} = \text{telescope's focal length} / \text{eyepiece's focal length} \times \text{Barlow power}$$

For example a telescope with a focal length of 400mm used with an 8mm eyepiece and  $\times 2$  Barlow will offer a magnification of  $\times 100$  ( $400/8 \times 2 = 100$ ).

### Focal Ratio

The focal ratio represents the *speed* of the telescope's optics, the focal ratio can be calculated by dividing the focal length by the telescope's aperture.

Telescopes with faster/shorter focal ratios like the AR80S f5 and AR90S f5.5 benefit from wider fields of view, and a subsequent increase in brightness and image resolution. Fast f/4-f5 focal ratios are generally best for lower power wide field observing and deep space imaging. On the other hand slow f/10 focal ratios and above are better suited to higher power lunar and planetary observation as well as high magnification imaging in general.

For example when imaging extended deep sky objects like nebulae and galaxies an f/4 telescope will capture four times the amount of light in the same time period when compared to a telescope with an f/8 focal ratio. The same does not apply to single point light sources like stars where aperture alone dictates what you can see.

## Field Of View

The field of view is the portion of the sky that is visible through the telescope and depends on the focal ratio of the telescope. In general higher magnifications result in smaller fields of view.

Short focal ratios (f/4) with wide fields of view greatly favour deep sky viewing and imaging, where focal ratios of f/10 and above are better suited for planetary and Lunar observation. Focal ratios in between these values (f6) may be considered appropriate for general use.

It is possible to calculate the field of view of a telescope given a certain eyepiece using the following formula.

$$\text{Actual Field of View} = \text{Eyepiece Apparent Field of View} / \text{Magnification}$$

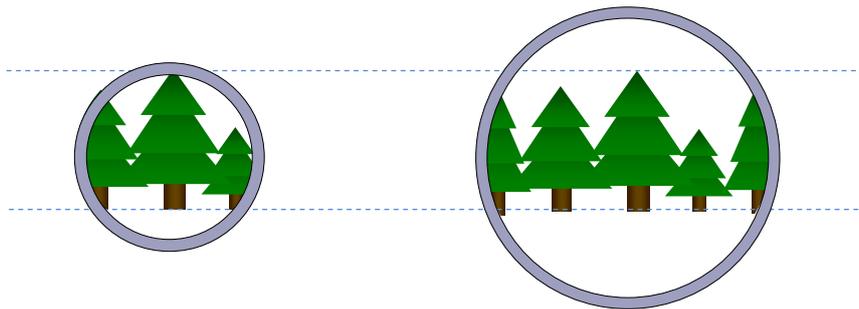
$$\text{where Magnification} = \text{Telescope Focal Length} / \text{Eyepiece Focal Length}$$

Consider a telescope with a focal length of 400mm and a 40mm eyepiece with a 70 degrees Apparent Field of View.

$$\text{Magnification} = 400 / 40 = 10 \sim \text{Actual Field of View} = 70 / 10 = 7 \text{ degrees}$$

It is worth pointing out that the eyepiece's Apparent Filed of View (AFOV) will vary from one eyepiece design to the next. An eyepiece with a larger AFOV will show you a larger area of the night sky at the same magnification and assuming that you are using the same telescope. Plossl eyepieces for example have an average 50 degrees AFOV, more expensive eyepieces costing several times more will typically have AFOVs of around 80 degrees. Large AFOV are desirable when scanning large areas of the night sky or when you would like to fit large objects inside the field of view.

The following examples illustrate the effect when using eyepieces of different AFOV but of the same focal length/magnification.



Assume that we are using a 10mm, 50 degrees AFOV eyepiece on the left and a wide-field 10mm, 80 degrees AFOV eyepiece on the right. Both eyepieces will show the target at the same magnification. However the wide-filed eyepiece on the right will reveal more of the scene.

Eyepieces of high AFOV are not useful when observing objects that appear small in the field of view, the obvious such objects are planets. In such case it is worth considering investing on higher quality eyepieces rhater than in eyepieces with wider fields of view.

## APPENDIX B

### Optics Care

Lenses and corrector plates can be treated as camera lenses for cleaning purposes. What makes them difficult to clean is the large size of such optical elements.

The general rule is not to touch the optics and only clean them when absolutely necessary, dust on the objective lens could be removed with very gentle strokes of a camel hair brush available at camera shops.

Another way to remove dust from an optical surface is with compressed photographic air which is free of contaminants.



Be careful and always make certain that the nozzle is propellant free. Hold the compressed air-can the right way up as otherwise they can discharge liquid propellant which will stain the optics. Stains on optics can be removed with optical cleaners used to clean photographic lenses. Always use compressed air at very low pressure as contaminants that may have landed on the lens could scratch the glass surface, never rush the cleaning process.

**CAUTION:** You can remove condensation from the optics with a hair-dryer set to 'cold'. Otherwise bring the telescope inside and let condensation to dissipate before putting on the cover. Place the telescope on a table and not on the floor. Never try to remove condensation using a cleaning cloth or similar, this will most likely smear the optics.

### Dual-speed Focuser Adjustment

If your AR80S came with a 1:10 dual-speed focuser this would have been adjusted at the factory. In certain cases it may be necessary to regulate the tension to improve performance by adjusting the silver thumb-screw below the focuser, *not too much and not too little*.

This may be required if the focuser was adjusted at room temperature and then used in sub-zero temperatures. Also as the focuser is worked-in over time surfaces smoothen out and the focuser may need slight re-adjusting.

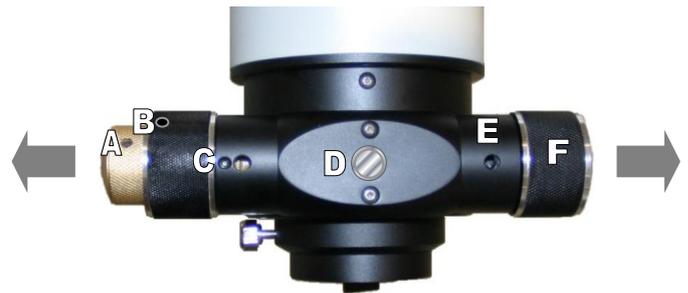


We recommend only adjusting the focuser beyond simply re-adjusting the silver thumb-screw, as outlined below, if there was a real need. The focuser has been designed to be fine-tuned **externally** by the user. It is also possible to re-adjust the **internal** clutch of the focuser mechanism to increase the tension for which the clutch will need to be removed for the adjustment to take place.

### External Focuser Tension Adjustment

Generally you will simply need to adjust thumb-screw **D**, this should be enough to obtain the desired result. It is worth making certain that screws **A**, **B** and **E** are tight, you will need a hex key to tighten these screws if they are loose.

Note that you will need to turn knob **F** until you can see screw **E**. Do not adjust or tighten any other screws at this point.



Otherwise you can adjust the tension further by following the procedure below.

1. Loosen thumbscrew **D**.
2. Adjust grub-screw **C** in tiny steps in conjunction with thumbscrew **D** and test.
3. Go to step 2 if focuser tension is not right.

## Internal Focuser Clutch Adjustment

In addition it is possible to internally regulate the tension of the focuser by setting the tension of the internal clutch.

Remove the focuser's rotational mechanism by un-tightening screws **C** and **E**, you will need to turn knob **F** until you can see screw **E**. Once the two screws are loose you can pull the two parts from either side.



Notice the two grooves on the brass part of the rotational mechanism.

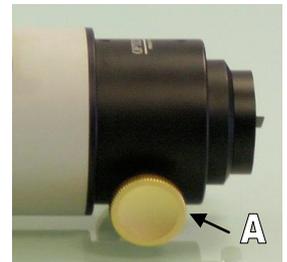
Use a wrench to tighten the part (clutch) as shown in the picture on the right to increase the amount of tension. You only need to slightly tighten the mechanism, tightening it too much will lock the clutch. If this happens you simply need to un-tighten the clutch and try again.

## Single-speed Focuser Adjustment

To set the single-speed AR80S focuser to a desired setting you will need to adjust the tension using the single thumb-screw that can be found under the focuser.

Simply turn the thumb-screw **A** one way to increase the Crayford focuser's holding capacity, turn the thumb screw the other way to reduce the holding capacity of the focuser.

Increasing the pressure will enable the focuser to hold more weight but the focuser will become slightly less sensitive. As such it is important not to unnecessarily over-tighten the thumb-screw.



## An Imaging Setup

The Opticstar short tube refractors are ideal for deep sky imaging. They can be used as part of an imaging system as illustrated below.



## APPENDIX C

### Opticstar AR80S & AR90S GOLD OTA Specification

Aperture	80mm	
Focal ratio	F5	F7.5
Focal length	400mm	600mm
Objective	Achromatic doublet	
Optical coatings	Broadband FMC (fully multi-coated)	
Optical tube	Internally anti-reflection coated, knife-edge baffles	
Dew shield	Retractable with metal screw-type cap	
Finder-scope saddle	Non guider versions only	
Focuser Mechanism	Dual Speed Precision Crayford or Crayford	Dual Speed Precision Crayford
Focuser Type	Rotatable 360 degrees (non-guide scope versions only)	
Focus adapter	Accepts 2" and 1.25" eyepieces and diagonals	
Focal tube travel	70mm (marked in 1mm intervals)	
Optical tube support	Dovetail or Collimating rings & dovetail	Dual ring & dovetail
Scope weight	2.1 - 2.2Kg	2.3Kg
Minimum tube length	310mm retracted dew-shield	330mm retracted dew-shield
Maximum tube length	365mm extended dew-shield	385mm extended dew-shield
Tube diameter	97mm	
Frontal dew shield diameter	110mm (screw-type aluminium cap)	
Construction	All metal construction	
Tube design	Short, suitable for use with bino-viewers (1.25" diagonal required)	

Aperture	90mm	
Focal ratio	F5.5	F8.8
Focal Length	495mm	792mm
Objective	Achromatic doublet	
Optical coatings	Broadband FMC (fully multi-coated)	
Optical tube	Internally anti-reflection coated, knife-edge baffles	
Dew shield	Retractable with metal screw-type cap	
Finder-scope saddle	Yes	
Focuser Mechanism	Dual Speed Precision Crayford or Crayford	Dual Speed Precision Crayford
Focuser Type	Rotatable 360 degrees or Standard	Rotatable 360 degrees
Focus adapter	Accepts 2" and 1.25" eyepieces and diagonals	
Focal tube travel	70mm (marked in 1mm intervals)	
Tube Rings	Dual ring with photographic 1/4" thread	Heavy Duty rings & Dovetail
Tube Weight (inc. rings)	2.2Kg / 2.3Kg (Dual speed focuser)	3.36Kg
Minimum tube length	385mm with retracted dew-shield	710mm with retracted dew-shield
Maximum tube length	465mm with extended dew-shield	890mm with extended dew-shield
Tube diameter	97mm	
Frontal dew shield diameter	110mm (screw-type aluminium cap)	
Construction	All metal construction	
Tube design	Suitable for use with bino-viewers (1.25" diagonal required)	

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