

Corrected Cassegrain Astrograph

CCA-250

INSTRUCTION MANUAL

TAKAHASHI

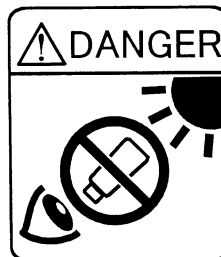
Thank you very much for your purchase of the TAKAHASHI CCA-250 Corrected Cassegrain Astrograph. The CCA-250 is an original design by Takahashi that uses parabolic primary mirror, a spherical secondary, and a 3-element corrector. There are also the optional reducers and extender producing great flexibility for imaging. In order to enjoy the CCA-250 to the limits of its capability, read this manual very carefully and familiarize yourself with all the functions of this astrograph. All the instruments have been carefully collimated and inspected before shipment. If there is any damage, contact your local dealer immediately.



WARNING

UNDER NO CIRCUMSTANCES WHATSOEVER SHOULD THE CCA-250 BE POINTED AT THE SUN.

DIRECT VIEWING OF THE SOLAR IMAGE WILL CAUSE INSTANT BLINDNESS.



CAUTION

- When you attach the tube assembly onto a mount, do it very carefully so as not to drop it. It could cause injury.
- Do not lay the tube assembly on any surface that is not completely level and sufficiently large to hold the CCA-250. An uneven surface could cause the instrument to fall off on to the ground.
- Do not place the tube assembly in the sunny place. The direct sunlight will heat up the interior of the telescope and could cause damage.
- Keep small children away from small objects like oculars to prevent them from accidentally swallowing a part.
- Keep the shipping carton in a safe place away from any flame because it contains flammable materials.

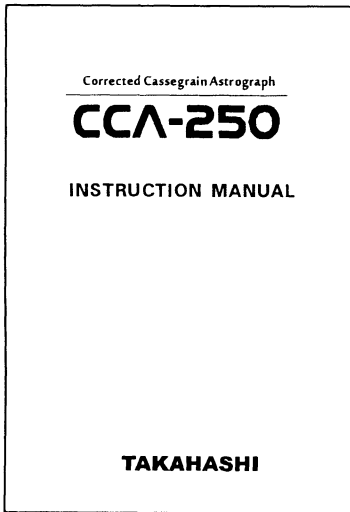
Table of Contents

Warning & Caution	2
Table of Contents	3
Specifications	4
Accessories	5
Tube Assembly Layout	6
Optical system features	7
Installation	8 -14
Photo/visual application	15 -18
System parts	19 -23
Collimation	24 -28
Care & Maintenance	29 -30
System Chart	31 -33

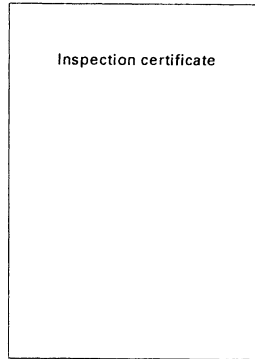
SPECIFICATIONS

Optical system	Corrected Cassegrain astrograph
Effective aperture	250mm
Effective focal length	1250mm
Effective focal ratio	5.0
Image circle	ϕ 88mm dia.
Backfocus	180.8mm
Metal Back	115.5mm
<With Reducer-CR 0.73X>	
Effective focal length	910mm
Effective focal ratio	3.6
Image circle	ϕ 38mm dia.
<With Extender-CR 1.5X>	
Effective focal length	1880mm
Effective focal ratio	7.5
Image circle	ϕ 40mm
<With 645 Reducer-CA 0.72X>	
Effective focal length	890mm
Effective focal ratio	3.6
Image circle	ϕ 60mm dia.
Outer diameter of main tube	306mm
Total length of tube assy	870mm
Total weight of tube assy	22.8kg [50.7 lbs] including 7x50 finder, dovetail adapter
Finder 7x50 w/apparent field of 4.2° w/reticle illuminator	
Accessories	Instruction manual, warranty & inspection certificate, dove-tail adapter, tools

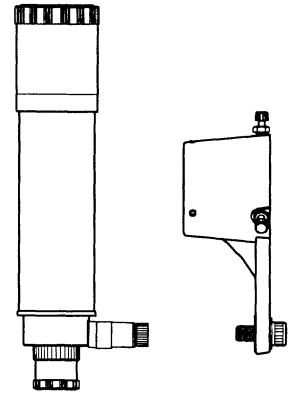
ACCESSORIES



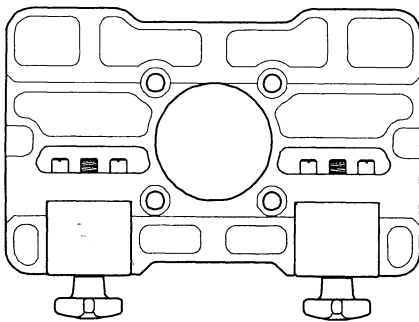
instruction manual



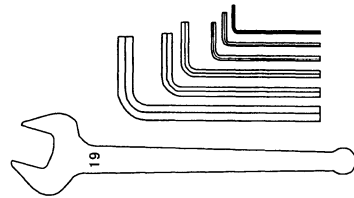
inspection certificate



7X50mm Finder & bracket
(not for U.S. market)



dove-tail saddle

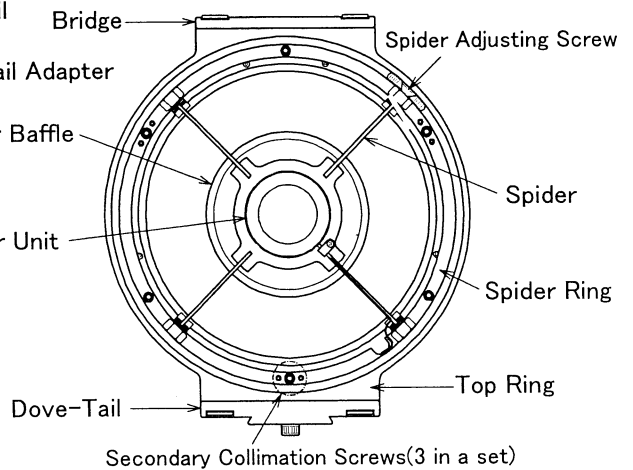
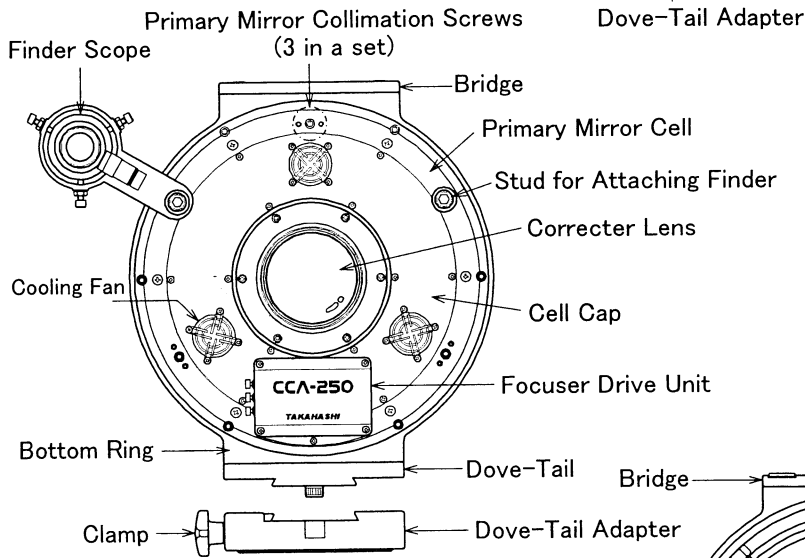
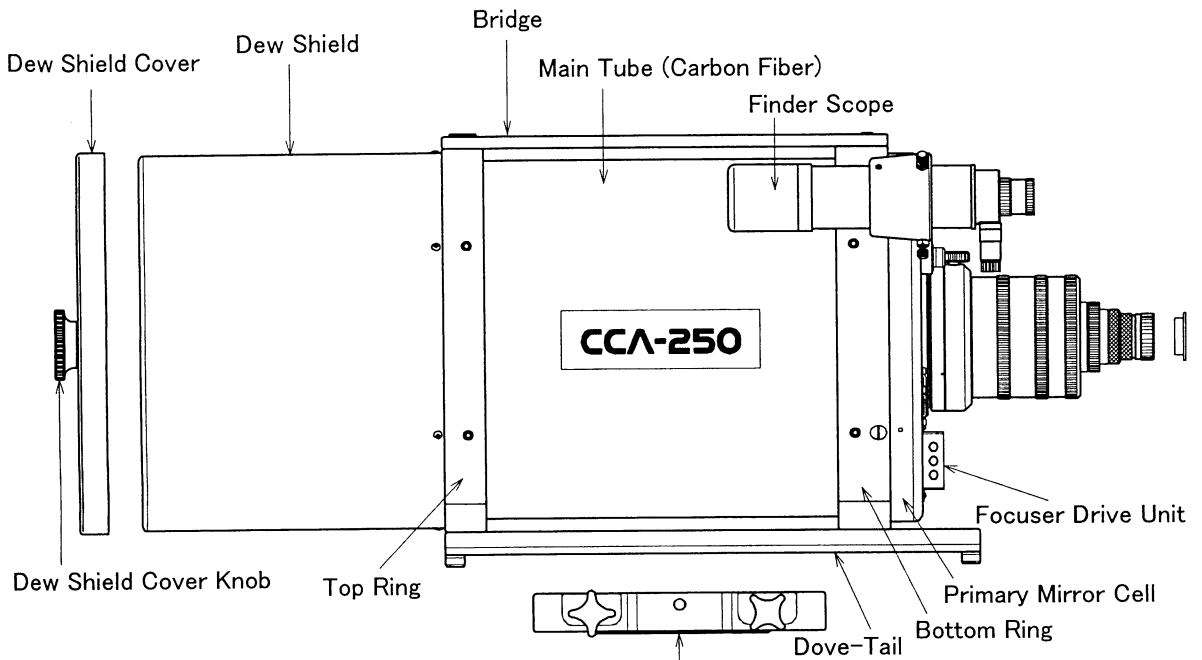


tools

[Note]

In order to use the auto-focus function, an ASCOM compliant software disc, USB cable, AC adapter for DC12V 1.5A (polarity center + plus) $\ominus \text{---} \text{---} \oplus$, are required.

LAYOUT OF TUBE ASSEMBLY



OPTICAL FEATURES

CCA-250 uses a parabolic primary mirror and a spherical secondary, which are easier to produce, resulting in an ideal optical system producing corrected images without astigmatism.

This optical design is an original and is an advance from the semi-Ritchey Chretien design making the curves of the primary and secondary same radius so as to make the total sum of Petzval zero. Moreover, the 3-element corrector can make the field perfectly flat surpassing the BRC design.

Optical performance at f/5, the CCA-250 can produce a 50mm image circle with less than 6-micron image in the center, able to easily cover a medium format and larger CCD with a total image circle 88mm at f/5. This large image circle will also be able to handle 67 size CCDs when they become available in the market.

The most remarkable feature of the CCA-250 is its ability to be a tri-focus astro imaging platform using the dedicated reducers and extender. The CCA-250 can be used at the native f/5, f/3.6 with the Reducer-CR 0.73X and f/7.5 with the Extender-CR 1.5X, which have been developed for the Takahashi's original Mewlon-CR optical systems. Moreover, in order to cover the larger image circle of future CCDs, a dedicated 645 Reducer-CA which produces 60mm circle with less than 10-micron image is now under development.

An ASCOM Compliant Auto Focusing System is standard. FocusMax and MaximDL can be used with this system to control critical focusing. An ASCOM compliant driver can be downloaded from the Takahashi website.

Please access:

[http://www.takahashijapan.com/support_e.html]

to download the ASCOM compliant driver for the Active Focus system of the CCA-250.

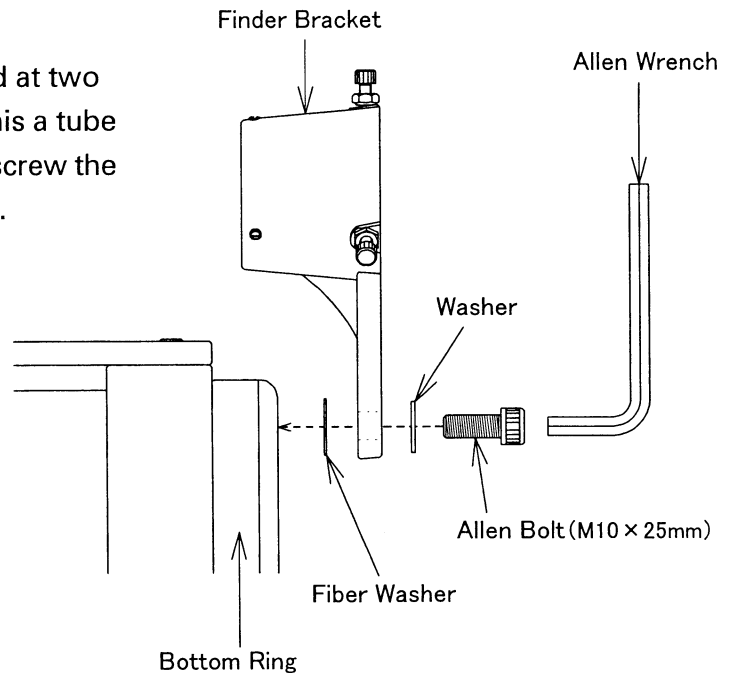
Cooling System:

3 cooling fans are provided on the mirror cell cover of the tube assembly. On/off operation for these fans is controlled automatically by ASCOM compliant software or manually. In order to run these fans, three sensors are provided to monitor the temperatures of the primary mirror, the inside and outside temperatures of the main tube.

Installation

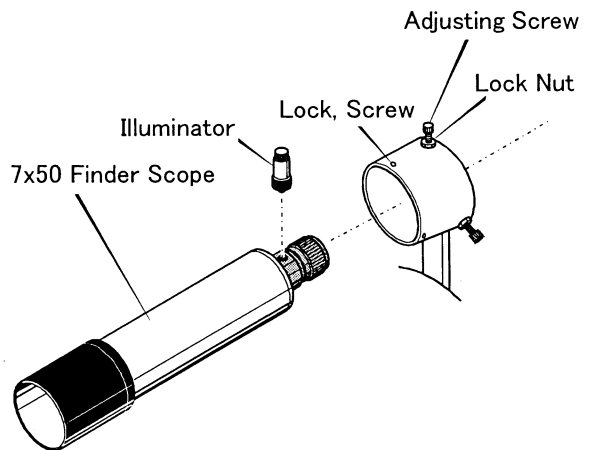
■ Attaching Finder Bracket

The finder bracket can be attached at two optional positions with M10x25 [this a tube holder bolt] bolt. Be careful not to screw the bolt only, which could hit the tube.



■ Attaching Finder Scope

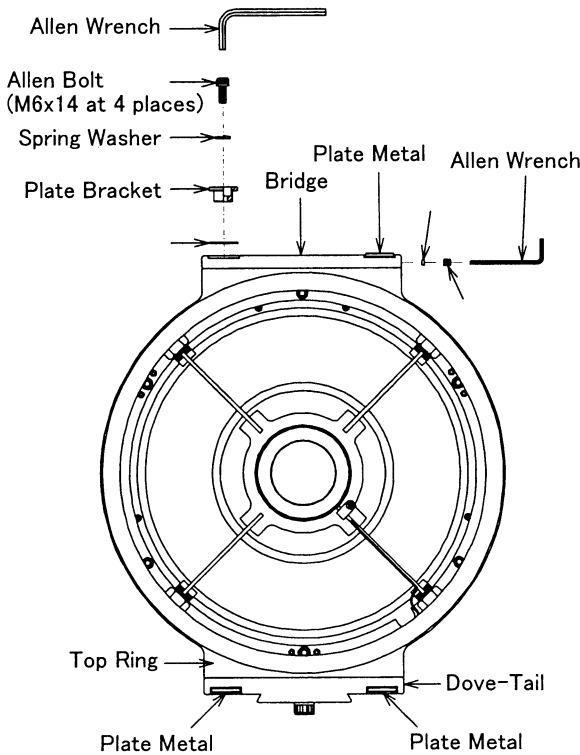
Pull the adjusting screws of the finder bracket to clear the space for the finder scope when setting. Remove the illuminator before setting the finder in the bracket. Then set the finder scope with equal space between the adjusting screws and lock the finder scope with adjusting screws. Again attach the illuminator in place.



■ Dove-Tail and Bridge

Do not remove the dove-tail or the bridge. These parts are made of aluminum and the main tube is made of carbon fiber. So, these are assembled by a special method to offset different expansion rates and contraction of these various materials. Usually there is no need to remove these parts, but if removed, return the resin washers to their

original positions. First, loosen the small screw a bit and loosen the M6 Allen bolt. When the plate is removed, the small resin piece set in the screw hole will come out.



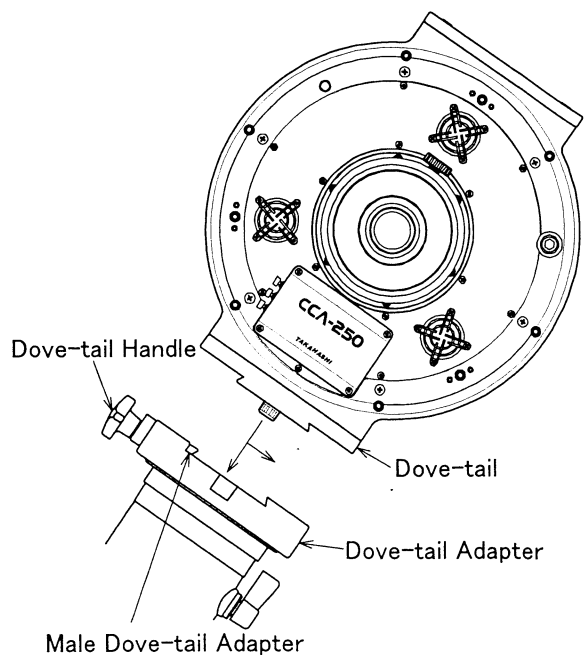
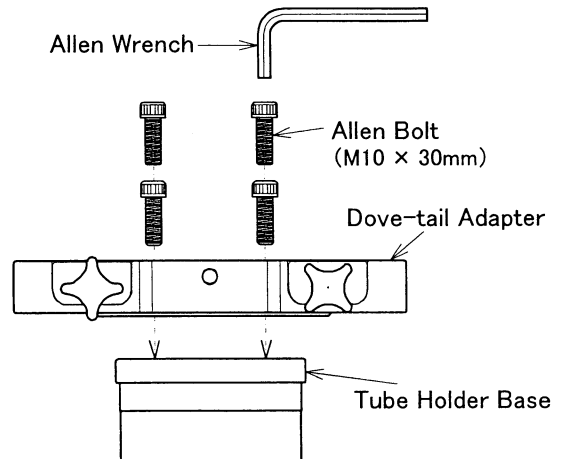
■ Placing the tube assembly onto the Mount

To place the tube assembly onto the mount, the dove tail saddle plate is used. This allows the tube assembly to be taken on and off the mount without tools, and if the tube assembly is not inserted into the saddle plate correctly, the OTA could fall out, possibly causing injury to the user or damage to the telescope. The weight of the tube assembly is about 20kg (44lbs). It is a good idea for two to place the CCA-250 on to the saddle plate.

1. Attach the dove-tail saddle plate firmly onto the mount with 4 ea. M10 x 30 Allen bolts.

2. Level the dove-tail so that the tube assembly can be set easily on the mount. Turn the dove-tail saddle plate clamping screws counter-clockwise until the scope is properly positioned.

3. Place the dove-tail attached to the tube assembly firmly into the key-way of the dove-tail saddle plate. Make sure that the tube assembly is firmly locked into the dove-tail saddle plate. Do not hold the adapters on the rear of the scope when lifting the tube assembly. Doing so could damage to the adapters.



■ Balancing

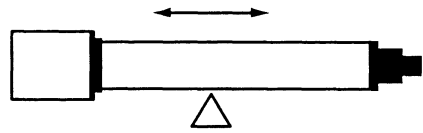
The CCA-250 is supplied with long dove tail to help with balancing a variety of imaging packages. When the tube assembly is placed on to the mount, balance it from front to back using the dovetail, and in R.A. by shifting the counter weights. When balancing, attach the imaging package to the tube assembly.

Then rebalance in the arc that the instrument will cover as the image is made.

This will insure good tracking by the mount.

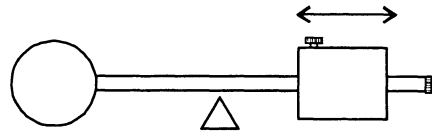
● Balancing in the Declination Axis

1. Loosen the Declination clamp and lock in position when the scope is horizontal. If the scope is out of balance, clamp the Dec axis and balance the load in RA first.
2. Then loosen the Declination clamp, holding on to the tube to keep it from swinging away and striking the mount, make the OTA horizontal.
3. Holding the scope with on hand loosen the saddle plate clamps slightly with the other hand, which allows the tube to be moved back and forth.
4. If the instrument is not balanced, loosen the Dove-tail handle and slide the tube assembly forward and backward until it is balanced.



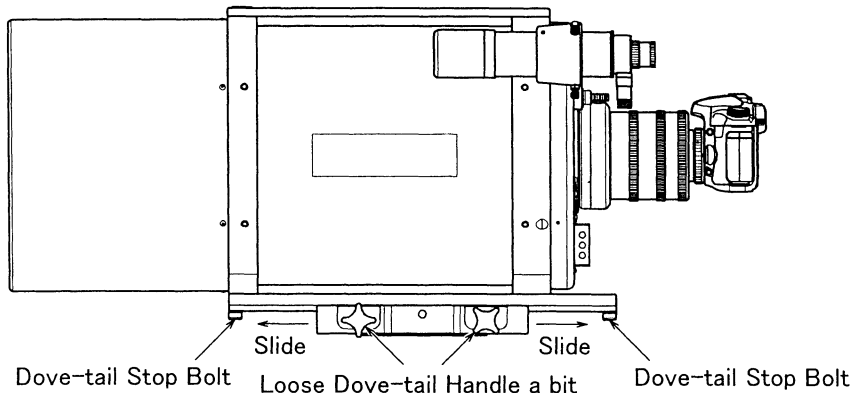
● Balancing the R.A. Axis

1. When balancing in the Declination is complete, lock the Dec. clamp.
2. Loosen the R.A. clamp and see how if the R.A. axis is balanced.
3. If it is not balanced, shift the counter-weight until balancing is complete.
4. Balancing may require an additional counter weight[s].



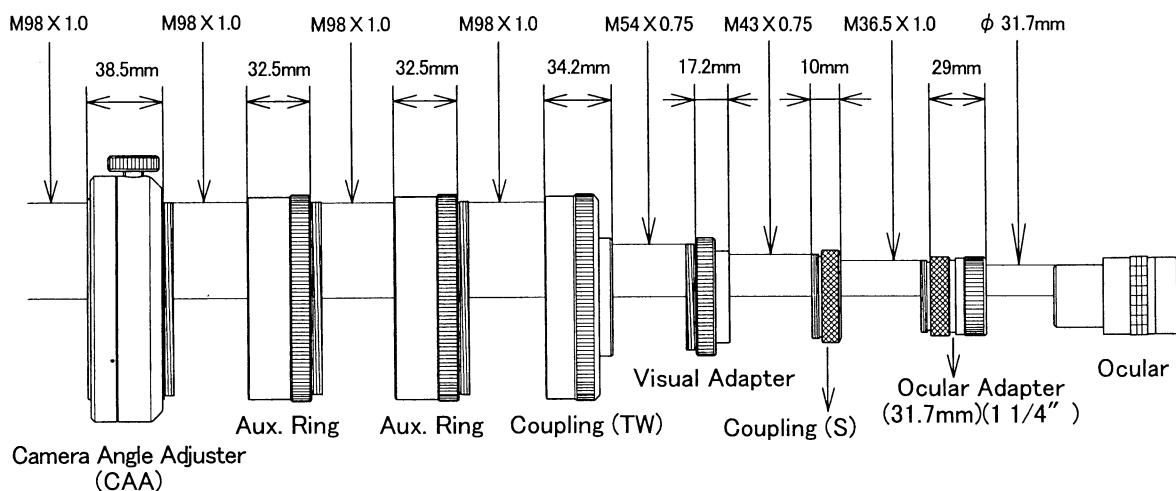
■ Camera and Balance

When the tube assembly is locked in the position where it does not move, you can attach a 5kg camera to the camera angle adjuster on the rear of the OTA so long as the scope and camera are balanced in Dec..



■ Attaching Adapters

Before shipment, the adapters have been attached for visual use as illustrated. In place of an ocular, an adapter cap is attached.

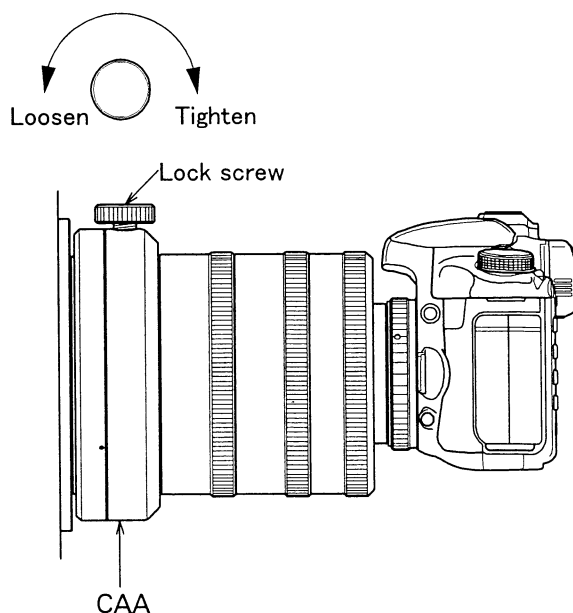


■ Attaching Other Accessories

Various imaging adapters can be attached. Please study the system chart so that the parts will be attached correctly. Incorrect attachment will not allow maximum performance and will not focus correctly and it will reduce the performance of the scope.

■ Camera Angle Adjuster (CAA)

The CAA is attached to the tube to allow the imaging package to be rotated 360°. Loosen the lock screw and then turn the CAA to any desired position. When the CAA is used, rotate the entire camera to keep the T-ring from coming loose. Check the focus after the camera is turned.



■ Focusing

In order to image any object sharply after the imaging package is attached, best possible focus is necessary. In order to use the CCA-250 to its maximum capabilities, precise focusing is necessary. The CCA-250 uses a computer controlled focusing system that moves the secondary mirror using a pulse motor. This system can also be operated manually.

■ How to manually operate the focusing system

A center positive DC 12V 1.5A AC adapter is used for the power source. Insert the plug into the power receptacle of the drive unit. An on/off switch is not provided so switching is made by inserting and pulling out the plug. When the power is on, the motor set on the secondary mirror starts to detect the original position. At first, it moves the secondary mirror to the primary mirror side and stops once. Then, it moves the secondary mirror near the focal point and stops itself. When FOCUS + (plus) is pressed, the distance between the primary and the secondary is widened and the focal plane will move inward. When FOCUS - (minus) is pressed,

the distance between the primary and the secondary is narrowed and the focal plane will move outward. Each FOCUS button ramps up the motor when it is pressed and gradually speeds up the motor when it is continuously pressed. When these buttons are pressed together for 6 seconds, the motor will detect the original position. When the focus button IN (red) is pressed, the secondary is shifted toward the opening of the tube and the focal plane will move inward. When the focus button OUT (white) is pressed, the secondary is moved toward the primary and the focal plane will move outward.

■ Fan Operation

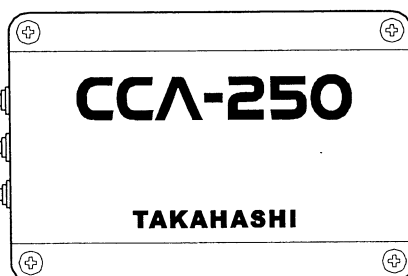
When focusing manually, the on/off fan switch operates the cooling fans.

When the button is pressed the cooling fans turn on and when the same button is pressed again the cooling fans turn off.

FOCUS + Switch (black):
Widens the distance between
the primary and the Secondary

FOCUS - Switch (red):
Narrows the distance between
the primary and the Secondary

Fan Switch (white)



■ Finder Alignment

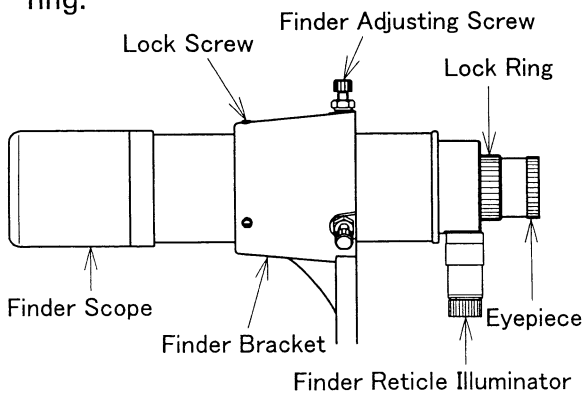
In the view field of a telescope, the magnification is very high and the view field is narrow so it is very hard to center a desired object. When a camera is attached for imaging, the view field is so dark and hard to see the object. Therefore, it is very difficult to make certain if the object is centered in the field.

A finder is a small telescope with wide apparent field and low magnification. So, if it is aligned with the main scope and a desired object is centered by it beforehand, the object in the field of the main scope is also centered. Finder alignment procedures are as follows.

● Focusing

When an object located far away and it is out of focus, proceed the following procedures.

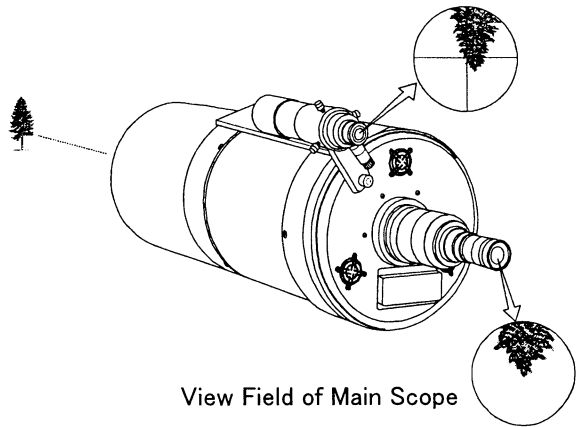
1. Loosen the lock ring.
2. Look for the best focus, turning the eyepiece clockwise and counter clock-wise, viewing the object.
3. When it is focused best, tighten the lock ring.



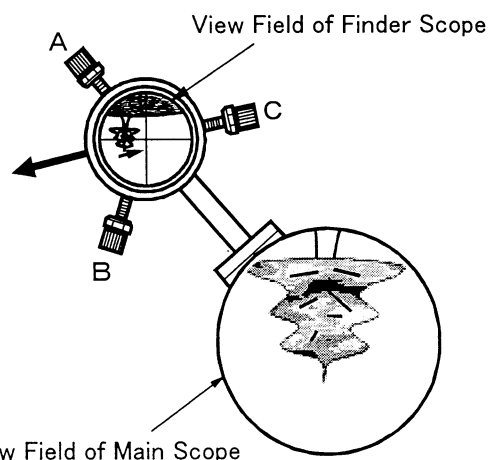
● Finder Adjustment

1. Attach a low power ocular to the visual back and center a conspicuous object located far away.

View Field of Finder Scope

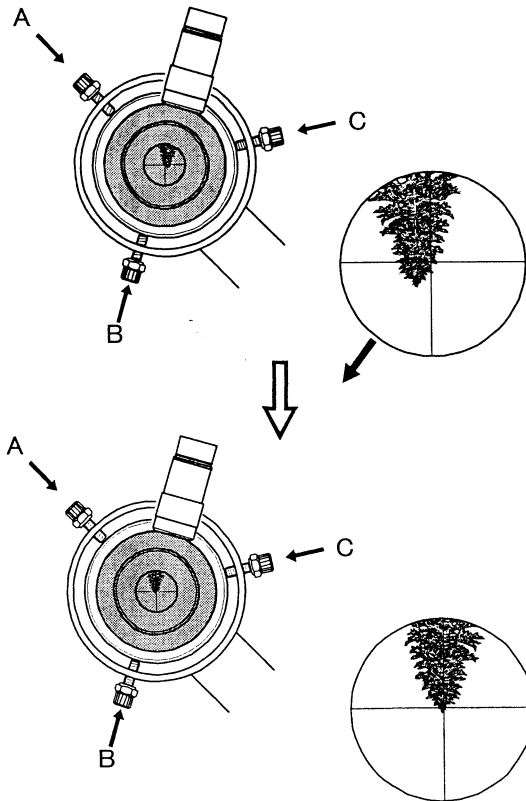


2. Change the eyepiece with high power one and center the object again.
3. If the object is seen different as shown in the illustration, adjust the finder scope so as to center the object with the following manners.
4. Turn all the lock nuts until they reach the head of the alignment screws.
5. In order to move the crosshair in the direction of the arrow, first loosen screw (a) and tighten (push) the finder with screw (c). this procedure will move the crosshair in the desired direction. The top of the finder will move in the opposite direction and the object will move in the direction of the smaller arrow. Refer to the illustration.



6. Similarly, adjust the direction of the finder with 3 sets of adjusting screws.
7. When the optical axes of both finder scope and main scope are paralleled, lock the finder scope with the lock nuts. Learn the relationship between the movement of the three adjusting screws. If the finder cannot be moved in the desired direction, loosen the locking nuts.

These procedures should be done in the daytime to prepare your observation in the night. Remember that the motor drive should be engaged when the finder is aligned with the main optics, using a bright star at night, because star is moving at the sidereal rate.

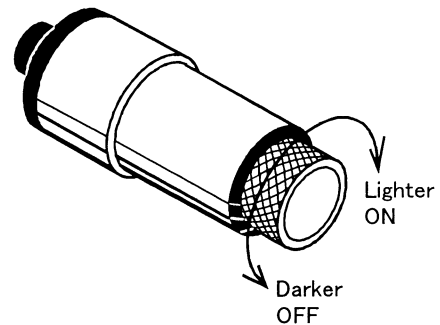


■ Reticle Illuminator

Takahashi 7x50 finder scope will accept the optional reticle illuminator. This illuminates the interrupted crosshair in the finder and

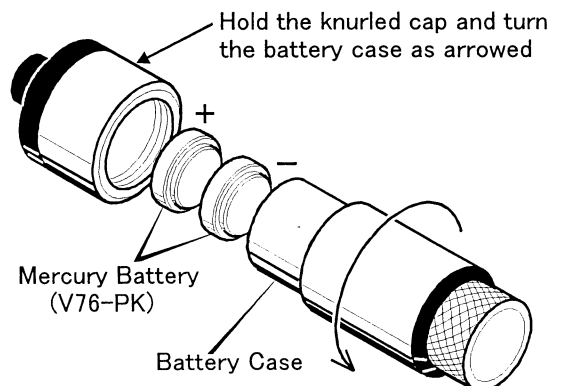
makes the centering objects in the view field easier. The illuminator is inserted into the hole covered by the slotted screw next to the eyepiece end of the finder scope.

If you wish to turn the illuminator on, turn the chrome knob clockwise. The Knob will click when it is turned on. This will allow the illuminator to be changed to suit the sky conditions. Turning the knob counter-clockwise will turn the illuminator off. The knob will click once again when it is turned off.



■ Replacing Batteries

In case the battery must be replaced, take out the case, turning it counter-clockwise as illustrated. Before replacing the batteries, clean the surface of the batteries and place them into the battery holder, checking the polarity. Use two silver cell 1.5v batteries S76 or equivalent.



Observation

■ Cooling System

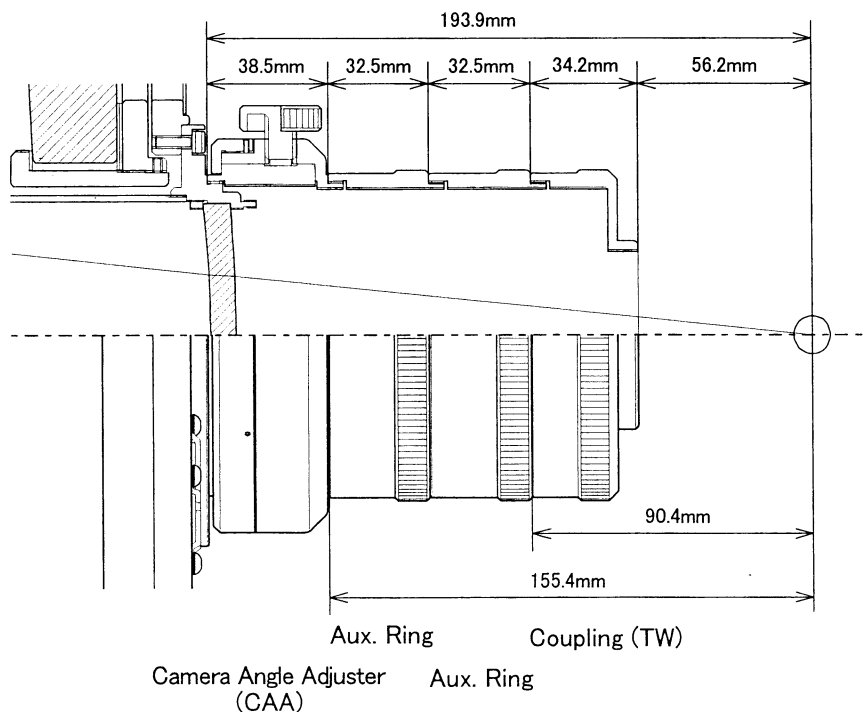
Before imaging the CCA-250 must equalize to the ambient temperature of the Imaging site. This process can be shortened with the use of the cooling system which is part of the rear cell, The system uses three sensors [mirror, inside tube and outside tube] and three low vibration motors which can be used manually or in conjunction with focusing software to bring the instrument to ambient temperature.

■ Astro Imaging at the Prime Focus

This is the imaging method placing the CCD at the prime focus plane of the CCA-250. The focal length of a telescope at prime focus is 1250 which needs a high quality autoguider to keep the stellar images perfectly focused. A CCD camera or 35mm DSLR can be used to make images.

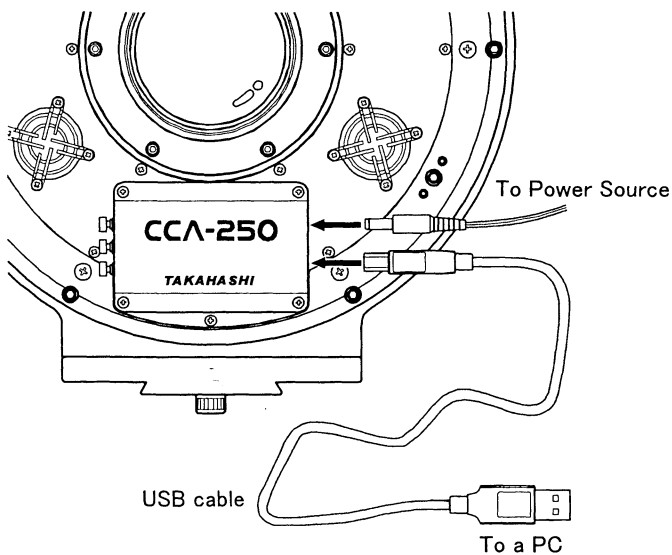
■ Back Focus

The back focus of this instrument is 155.4mm from the CAA and 193.9 from the rear of the mirror cell. It is important that the CCD chip to be placed precisely at the focal plane. This will insure the best possible image.



■ Focusing

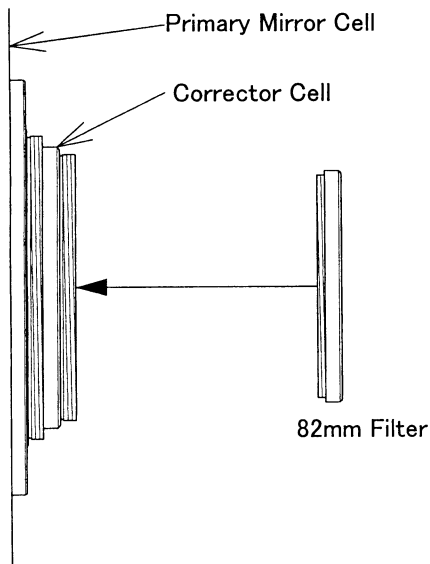
The CCA -250 uses an ASCOM compliant Activ Focus focusing system that can be controlled with popular focusing software. This software allows the CCA -250 to use computer controlled focusing. An ASCOM download is available on the Takahashi Japan website as well a Takahshi America website. When an object is set to be imaged, connect your PC with your CCA -250 and focus by using an ASCOM compliant software focusing software available. For further details, refer to the instruction manual attached with the software that is used.



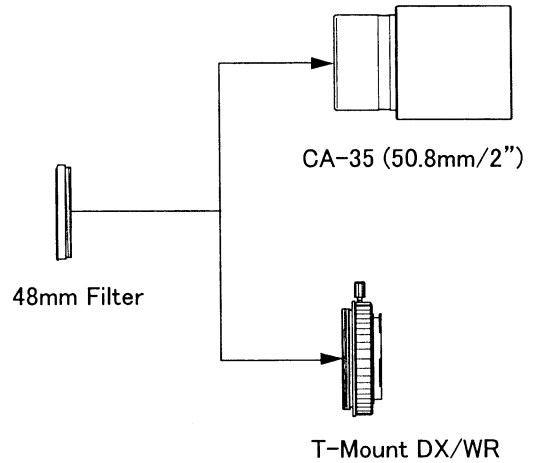
■ Filters

Some of accessories for CCA-250 can accept 48mm, 58mm, and 82mm filter. When necessary, you can use them as illustrated. Be careful some filters will possibly produce ghost images.

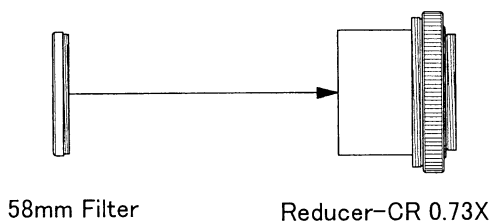
- An 82mm filter can be attached on the corrector cell.



- A 48mm filter can be attached on the CA-35 (50.8mm / 2") or on the T-Mount DX-WR. The filter with large attaching frame can not be attached on these accessories because of small spaces.



- A 58mm filter can be attached on the Reducer-CR 0.73X.



■ SOME PRECAUTIONS ON IMAGING

● Trial Imaging

After the imaging package has been attached and focused precisely, it is a good idea to take a 5-minute test exposure to make certain that everything is correctly set.

● Guided Imaging

In the optical system which can produce sharpest images as CCA-250, slight guiding error will make images deformed. Therefore, precise tracking and guiding are required. In the CCA-250, its f-ratio is so dark that a long exposure is necessary for imaging. If there would be some plays and rattles around the guiding system, no precise guiding can be expected. Please use a firmly built guiding system.

● Back Focus

Focusing in this instrument is made by moving the secondary mirror by a motor. In order to have the best possible capability of the instrument, the various parts for imaging are attached correctly according to the designed back focus. Study the system chart very carefully and attach your imaging package strictly according to the back focus.

● Tube Current

When the CCA-250 is taken out, there will be air currents inside the tube that will distort imaging. So, it is necessary to wait until the temperature inside and outside the tube is equal. When the telescope is brought outside, the temperature inside the tube will be higher than the outside air.

So, there will be active air currents inside

the tube. One source of the turbulence inside the tube is the heat radiated by the primary mirror as it cools. This temperature equalization process should take about one hour.



Cautions

When imaging at high magnification, pay careful attention to balance. Rebalance the telescope when the object is placed at the center of the camera. If the telescope is moved to another object, then rebalance it in the position in which the imaging is taken.

Never loosen the clamps of the mount when the telescope is unbalanced. All the clamps should be tight after the instrument is balanced. Otherwise, the instrument will possibly swing and cause damage.

ACCESSORIES FOR IMAGING

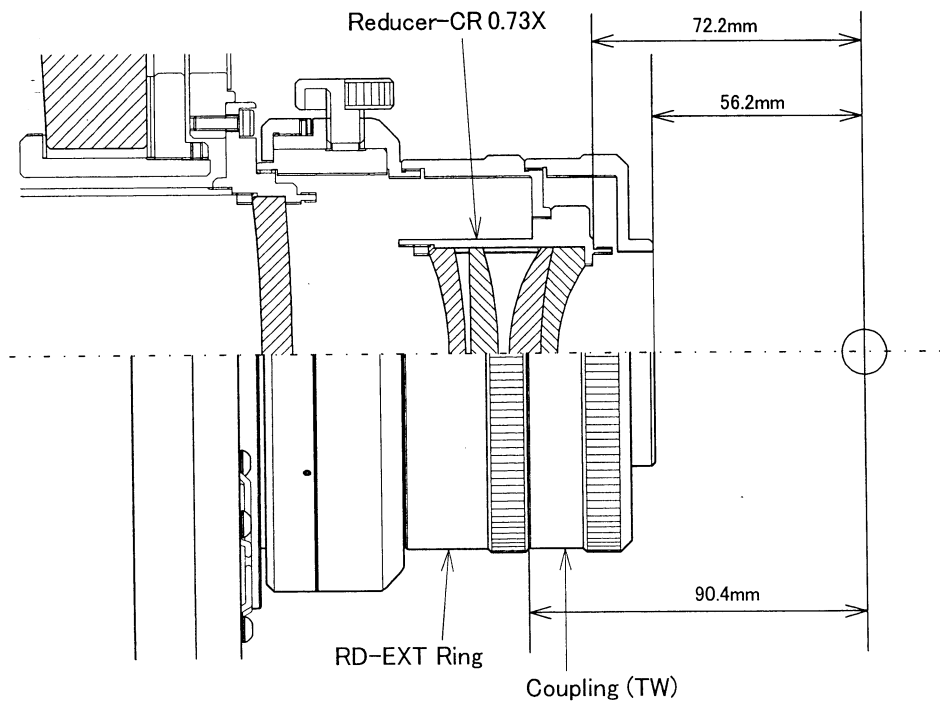
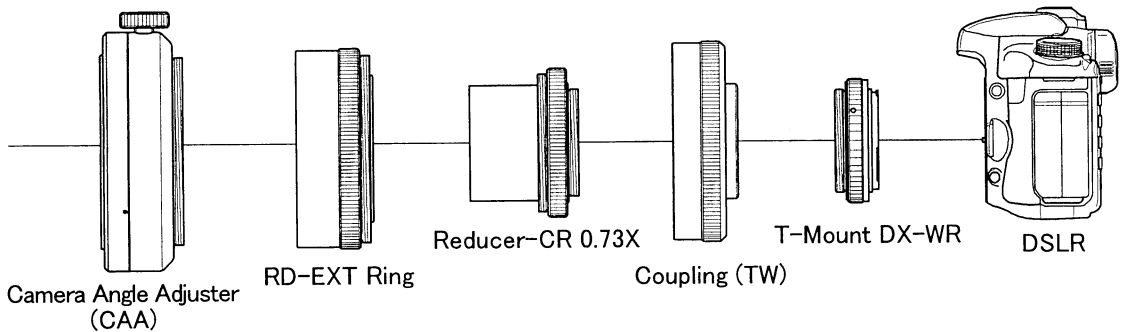
In order to image with CCA-250 a wide range of optical accessories and spacers are available that will produce outstanding images.

■ Reducer-CR 0.73X

Reducer-CR 0.73X changes the focal length to 910mm (f/3.6). Imaging with a DSLR needs the following accessories as illustrated.

Specs:

Focal length	910mm
Focal ratio	f/3.6
Image circle	38mm

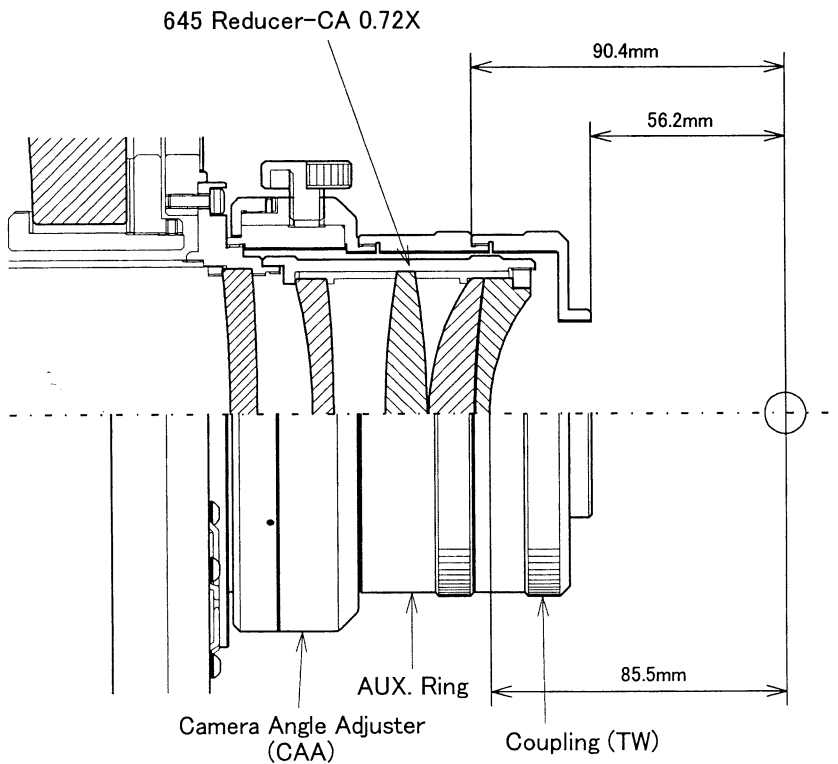
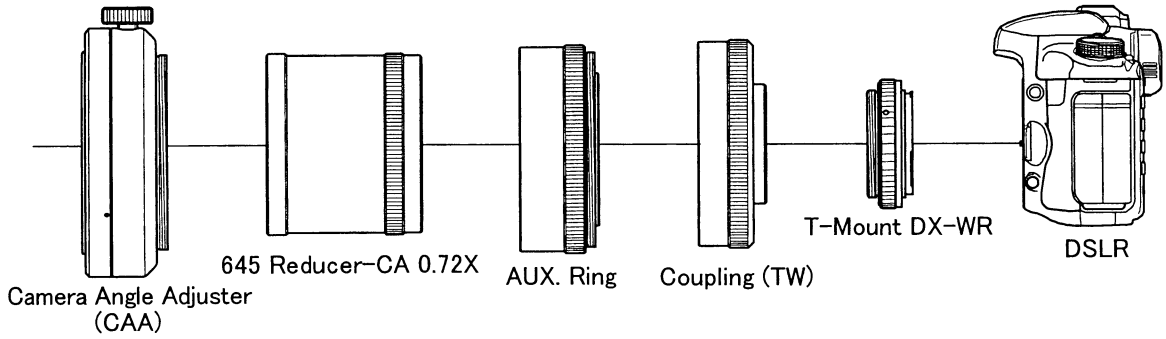


■ 645 Reducer-CA 0.72X

645 Reducer-CA 0.72X which produces a 60mm image circle is suitable to be used with large chip CCD cameras and full frame 35mm DSLR's as illustrated below.

Specs:

Focal length	890mm
Focal ratio	f/3.6
Image circle	60mm



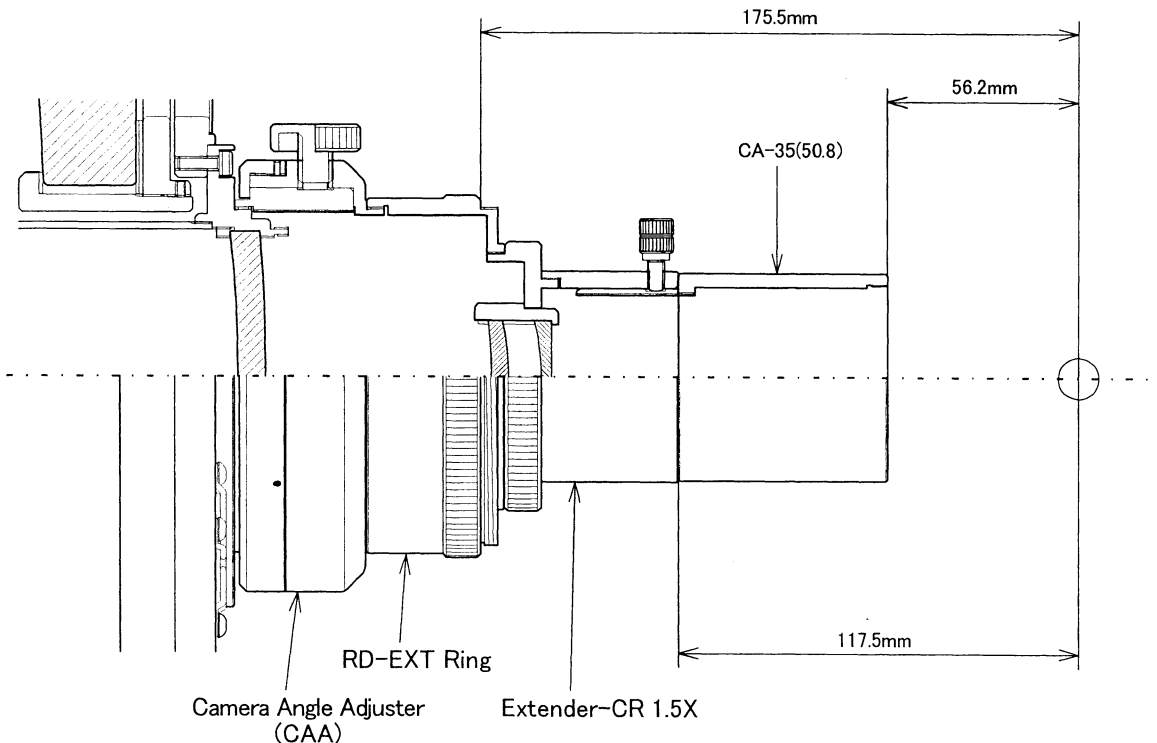
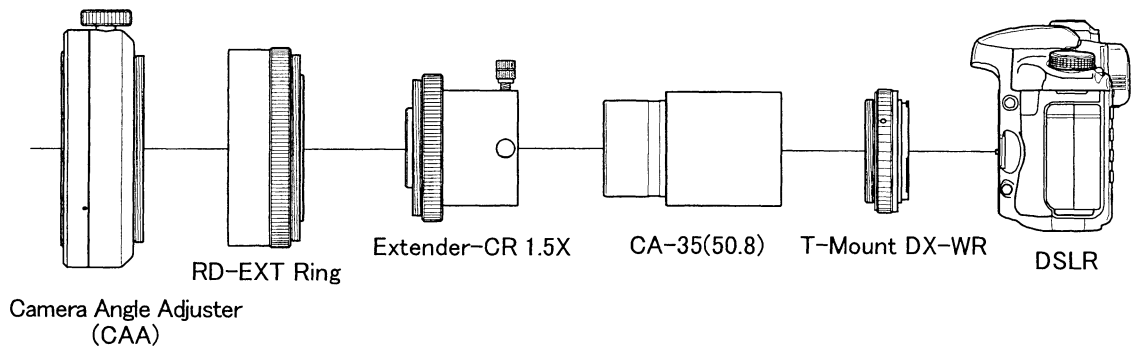
■ Extender-CR 1.5X

Extender-CR 1.5X can extend the focal length by 1.5X, will produce a large image scale for globular clusters, smaller nebulae and galaxies with small apparent diameters. In order to attach an imaging package, two methods are available: a standard Method Heavy Duty Method.

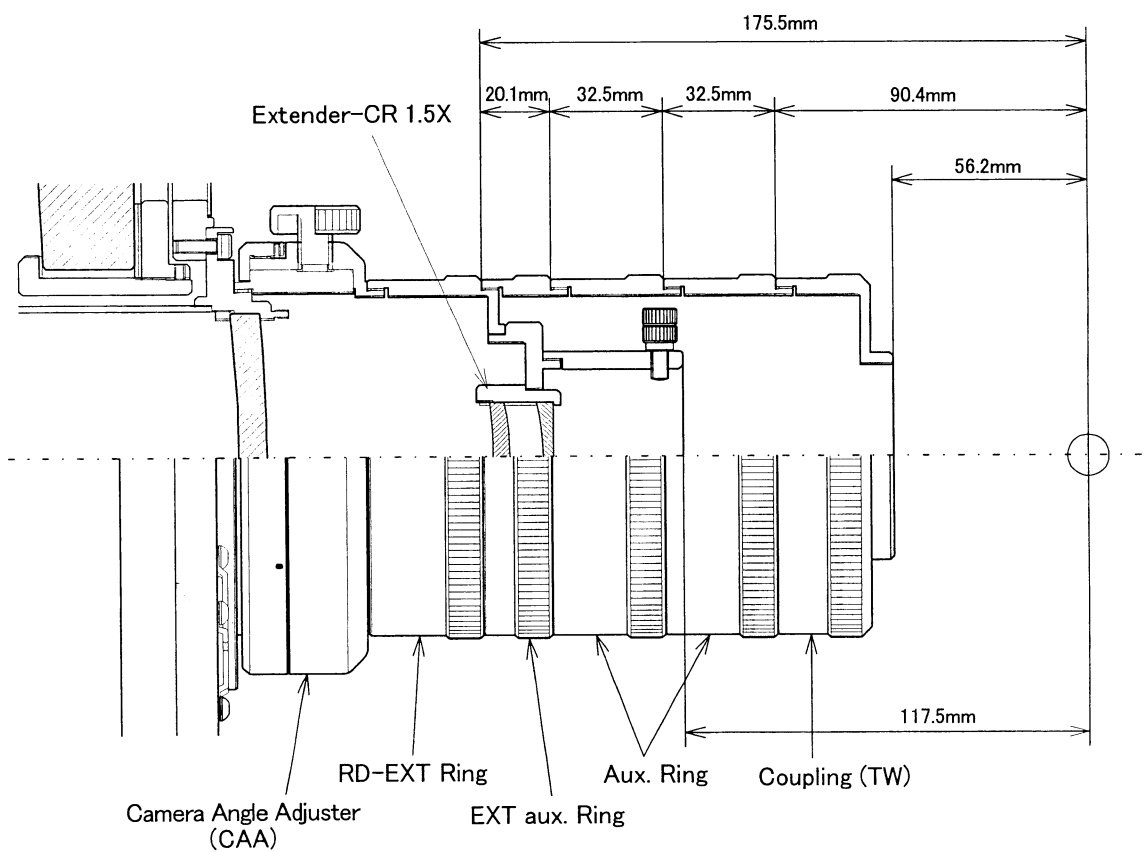
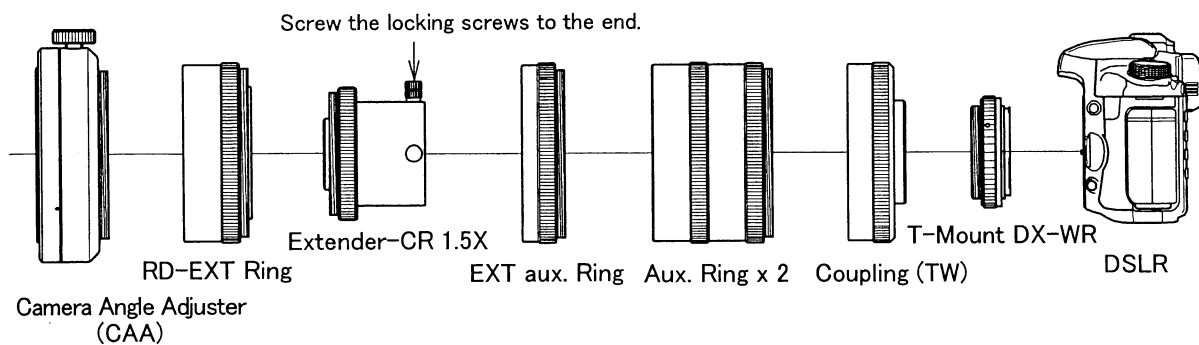
Specs:

Focal length	1880mm
Focal ratio	f/7.5
Image circle	40mm

● Standard Method



● Heavy Duty Method



■ RD-EXT Ring

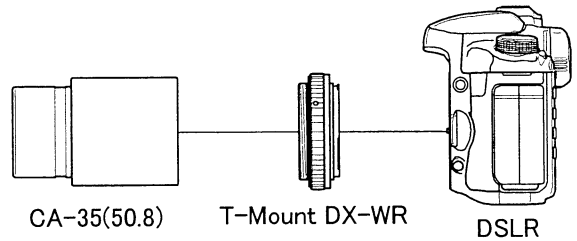
RD-EXT Ring attaches Reducer-CR 0.73X or Extender-CR 1.5X to a DSLR.

■ CA-35

CA-35 is necessary to attach a DSLR. In case Extender-CR 1.5X is used, the CA-35(50.8) is convenient to attach and detach a DSLR camera. In case other optical accessories are used, the dedicated CA-35 is not necessary, but the Coupling (TW) can be used.

■ T-Mount DX

T-Mount DX is used to attach a DSLR camera at the prime focus application, and with Reducer-CR 0.73X, or Extender-CR 1.5X, or 645 Reducer-CA 0.72. Wide T-mounts are available for EOS and Nikon.



■ Attaching a CCD camera

DSLR's and CCD cameras can be attached with either a T-mount or threaded adapters. In either case these methods insure a firm connection and which will maintain the correct metal back distance and produce the best possible images.

Cautions

The camera T-mount should be cleaned after each use to insure any dirt or dust is removed. Failure to do so could cause the camera to jam and tilt the body which would show elongated stars. If the images are not flat, check to see if the T-mount is totally clean.

COLLIMATION

When collimating the CCA-250, use a 2nd-3rd magnitude star as a reference. Bring it at the center of the view field and defocus the image and check the intra and extra focal images. If the diffraction pattern of the star is seen as eccentric, collimation should be performed as illustrated below.



Fig.1



Fig.2

The diffraction patterns of the star

Tools used:

- Collimating telescope available optionally
- Allen wrenches provided
- + (plus) driver
- Equatorial mount
- Oculars

■ Collimating the Secondary

A circular mark is stenciled at the center of the secondary mirror. If the mark is shifted, collimation is necessary.

1. Attach the collimating telescope as illustrated.

2. Focus the secondary, looking into the collimating scope. Refer to the fig.3. The fig. 4 shows the optical axis is collimated. As shown in the fig. 5, if the mark and the reflected image of the collimating scope are not seen as concentric, then collimation of the secondary is required. If they are seen as concentric, start the next step: collimation of the primary.

Reflected image of in the collimating scope

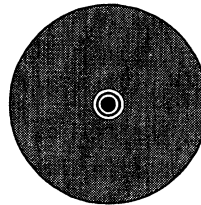
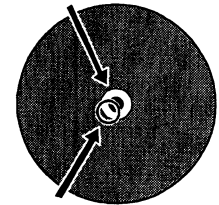


Fig.4



The secondary mark Fig.5

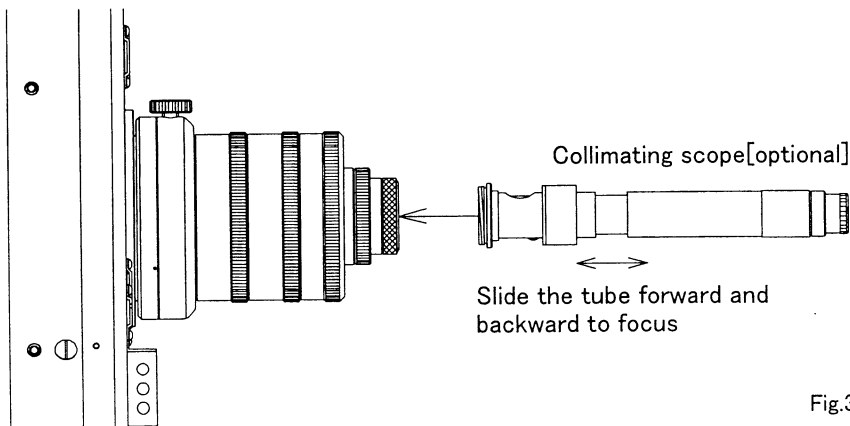


Fig.3

3. Remove the dew shield. Pull it horizontally, after removing 6 screws with a screwdriver. Be careful not to miss any of these small screws.

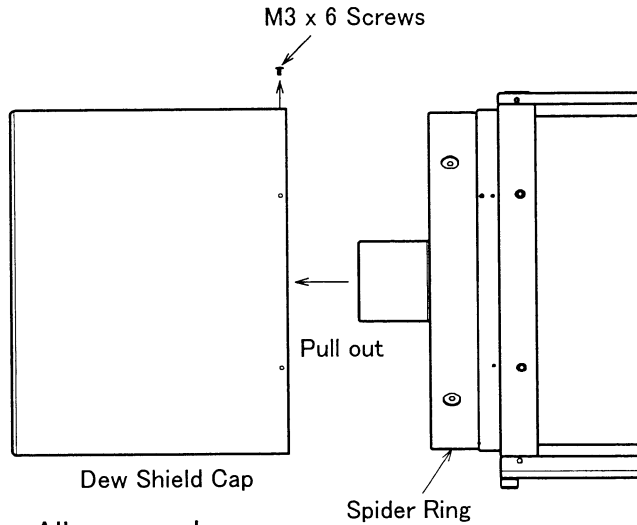


Fig.6

4. Loosen, with the 2mm Allen wrench provided, the collimating lock screws located at 3 places on the side of the top ring. Loosen 3 spider lock screws (M5 with hexagonal hole) located on the opposite side of the collimation lock screws, until it will not be tighten when collimation is performed. Refer to the fig.7.

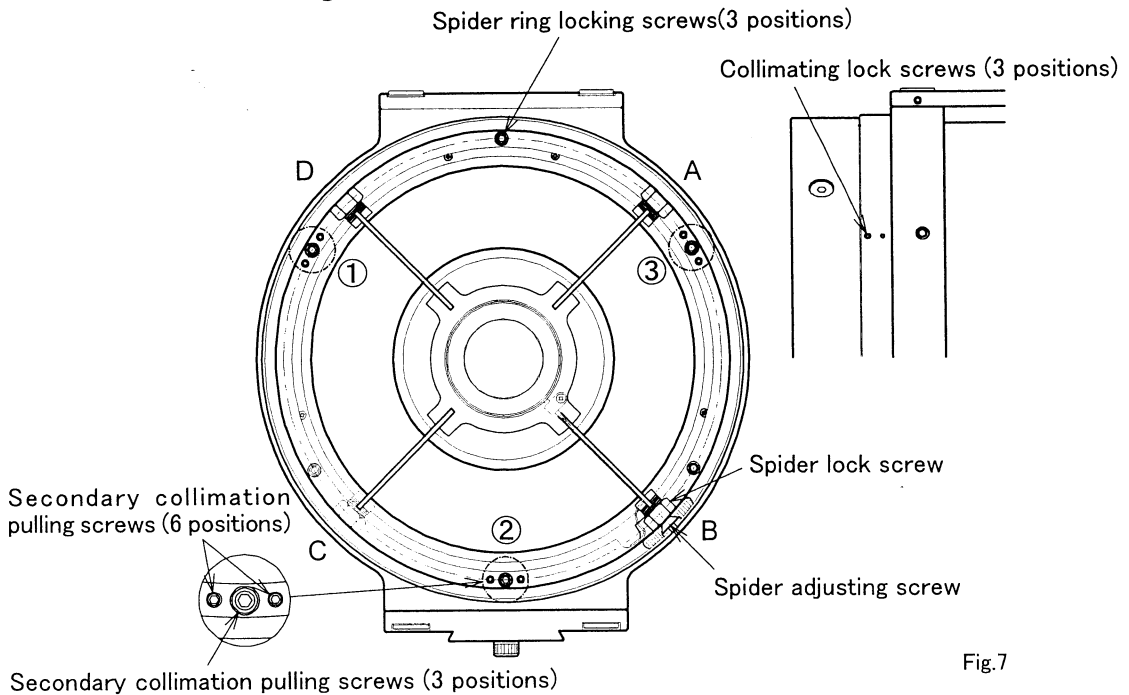


Fig.7

5. Check the movement of the secondary mark. The Fig. 8 shows what is seen when looking into the collimating scope and the Fig. 7 shows what is seen from the top of the tube. In the Fig. 8, the secondary mark is seen shifted toward the B wing of the spider. Adjusting the shifting in the Fig. 8 is as follows.

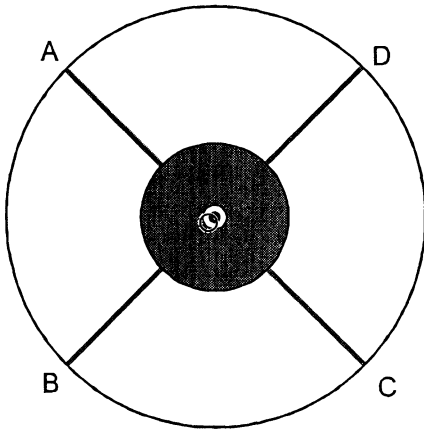


Fig.8

6. Adjusting screws for the secondary optical system: The pulling screws with hexagon hole provided at the center and the pushing screws positioned on both side of the pulling screws. Refer to the Fig. 7.

Basic adjustment is to loosen the pushing screws and to tighten the pulling screw located at the direction where the secondary mark shifts or to loosen the pulling screw and to tighten the pushing screws located at the opposite direction where the secondary mark shifts. This procedure will make the mark match with the reflected image in the collimating scope.

[Note 1]

Repeating this procedure will make the mark and the reflection image of the collimating scope seen nearly concentric, but one way adjustment will make the distance between the primary and the secondary wider than that of designed value. This will make the instrument less capability than originally designed. Therefore, adjustment should be so made that the distance will not be varied. To achieve this, adjustment should be made with screws located at both side.

[Note 2]

The screws should be adjusted, set by set, and locked firmly. Then, adjust the other set of screws. Otherwise, the spider ring will move down by its own weight, making the center of the secondary shifted.

7. When the marks have been adjusted in concentric circles, firmly tighten all the screws as seen in the Fig. 4 to tighten the spider ring.

8. After the adjustment of the secondary has been completed, make certain collimation is perfect, using an actual star. If the optical axis is still shifted, the primary mirror needs to be collimated.

■ Collimation of the Primary

In the event the intra focal and extra focal images in the field are not concentric, after the secondary has been well collimated, then collimation of the primary is required using the following procedures, with an actual star.

1. Attach the instrument on the mount. The mount should be polar aligned and ready to do guiding at the sidereal rate.
2. Attach the ocular adapter to the visual back and an ocular which can produce about 100X magnification.
3. Loosen with 2mm Allen wrench 3 sets of the lock screws, which lock the optical axis of the primary. Refer to the Fig. 9.
4. Center a 2nd magnitude star in the field. Then, slightly defocus the star using +/- buttons on the drive unit and see the intra and ultra focal star images. If the images are seen not concentric as shown in the Fig.10, adjust it so that the pattern becomes concentric as shown in the Fig. 11.
5. As in the secondary adjusting system, the screws with hexagon hole are the pulling screws and the ones at the both side of the pulling screws are the pushing screws. Refer to the Fig. 9.

The diffraction patterns of the star



Fig.10



Fig.11

The primary adjusting pulling screws (at 3 positions)

The primary adjusting pushing screws (at 6 positions)

Primary mirror setting screw

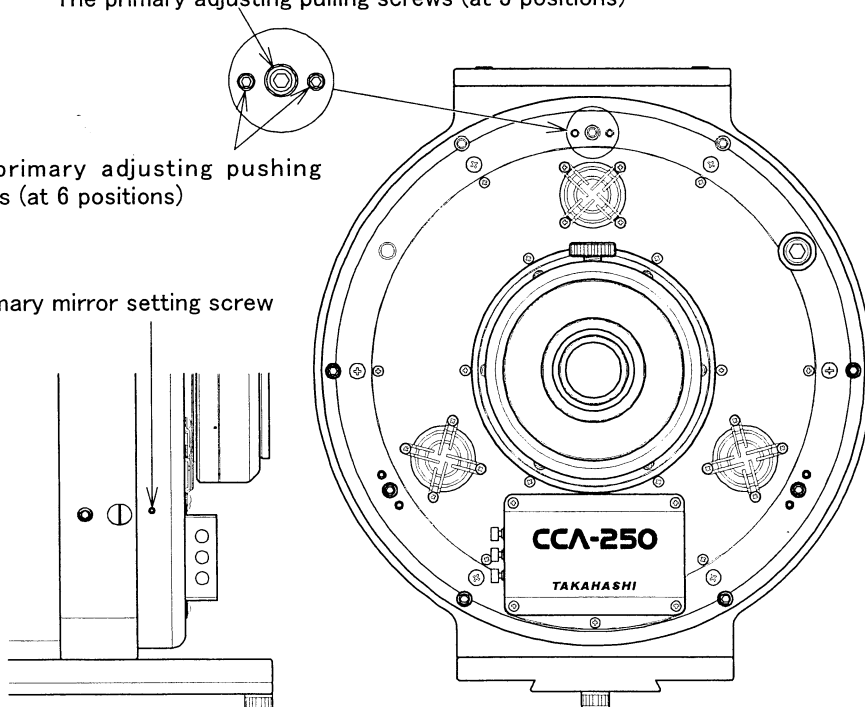


Fig.9

In case the intra and extra focal images are shifted toward upper left, the adjusting method is as follows.

The basic method to adjust the scope is to loosen the pulling screw and tighten the pushing screws. Then, the images will gradually become concentric. This is accomplished when the screws at the opposite side are adjusted.

[Note 3]

If the primary is adjusted one way only, this makes the distance between the primary and secondary wider, losing the original capability. Therefore, keep the distance as normal as possible, using all adjusting screws.

[Note 4]

The screws should be adjusted, set by set, and locked them firmly. Then, adjust the other set of screws. Otherwise, the whole primary would go down by its gravity and off center.

[Note 5]

In the process of collimating, a star at the center of the field will go off center. Therefore, keep the star centered by using the mount.

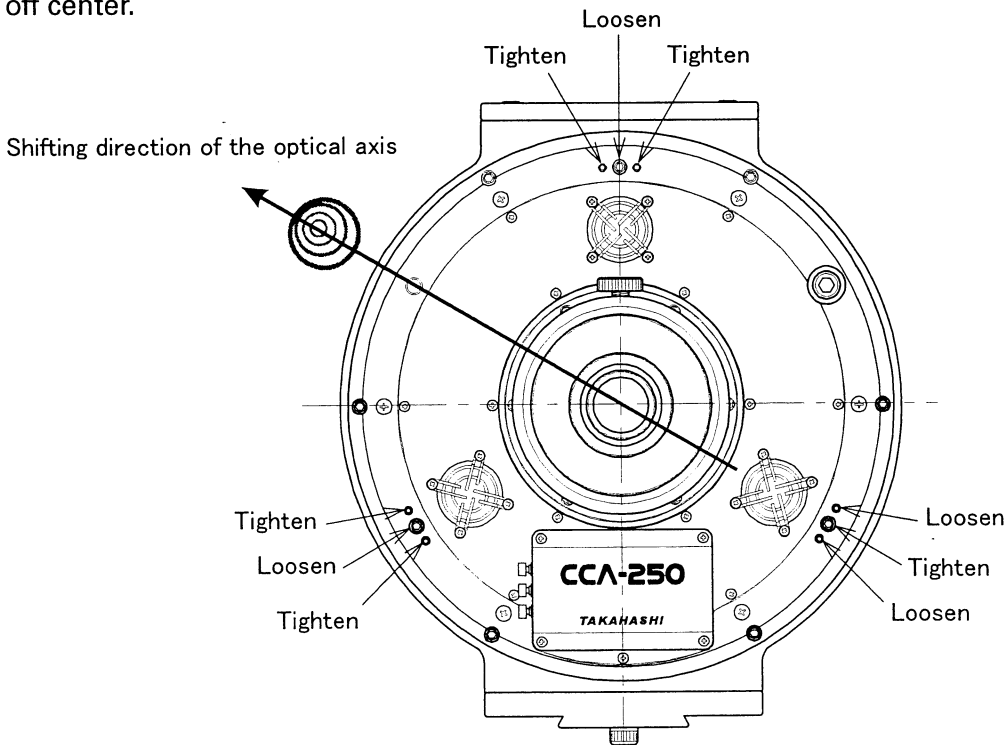
[Note 6]

A pair of the pushing screws at the both side of the pulling screw should be tightened evenly.

[Note 7]

Adjusting the primary is very delicate work. If all the pushing screws are tightened evenly, star images are seen deformed and astigmatism would appear. In this case, adjust the screws so as to form the intra and ultra images seen real circle.

6. After the collimation for the primary has been completed, check all the adjusting screws are evenly tightened. Then, tighten the primary lock screws (3 positions) on the side of the bottom ring.



Care & Maintenance

Just like a Newtonian reflector, the surface of the mirror is exposed directly in the air. If dust and dew adhered on the surface are left as they are, the images will be blurred, reducing the image contrast. Blow the dust particles with a blower with the following procedures at regular interval.

When the primary cell is attached again, align the reference marks of the primary cell and the bottom ring. Then, the optical axis will remain collimated.

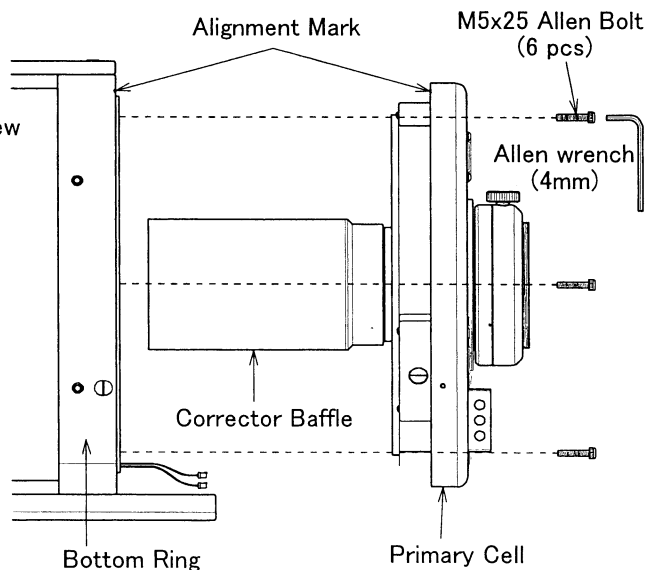
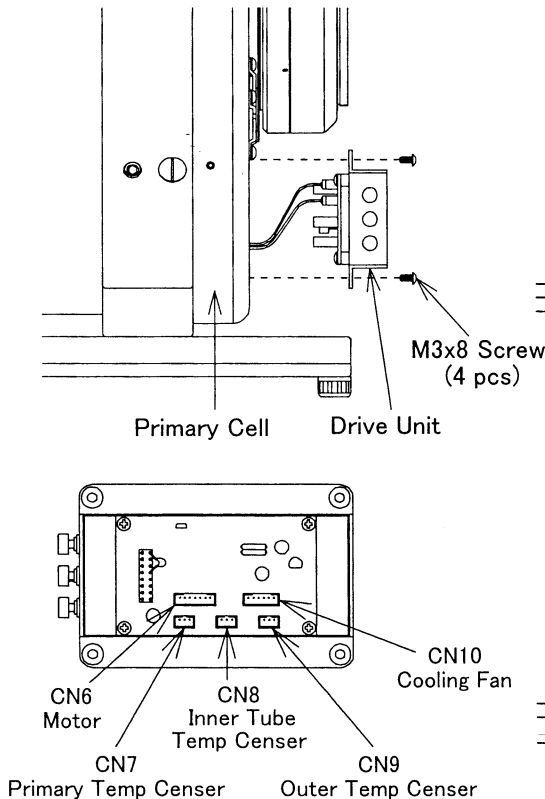
● How to detach and attach the primary cell

1. The procedures should be done, keeping the tube assembly horizontal. At first, remove all visual back except the CAA. Then the corrector lens will appear. Be careful not to damage it.

2. Next, remove the Drive Unit, which is attached with M3x6 screw (4 pcs). So, remove them by a + driver. 5-wires are connected to the Drive Unit. Out of these, detach carefully the ones connected to CN6 Motor and CN8 Inner Temp Censer.

3. Push in the detached wires in the hole appeared between the primary and the primary cell after the Drive Unit has been removed. Then, lock the Drive Unit on the primary cell again.

4. The primary cell is attached on the bottom ring with 6 M5x25 Allen bolt. Remove these bolts, with 4mm Allen wrench, except the one located at the upper part of the primary cell. Finally remove the bolt, supporting the primary cell. Now the primary cell has been separated from the bottom ring. Place it in a safe place with the CAA on bottom. This part is the heaviest part of the tube assembly. Therefore, handle the cell carefully.



5. When the last bolt is removed, take out the primary cell with the primary mirror, supporting it by your hands around the edge of the primary cell, shifting horizontally with great care not to hit the lens baffle onto the inside of the bottom ring. Exercise great care with the 2 wires remaining on the bottom ring so that they will do not become tangled inside of the primary cell.

6. When the primary cell has been removed, blow out dust particles with a hand blower, with the primary mirror surface up.

7. To attach the primary cell, do the reverse procedure.

8. First, match the alignment marks of the primary cell and the bottom ring. Then, make it horizontal. Insert the 2 wires staying at the bottom ring into the gap between the primary and the primary cell and bring the corrector baffle closer to the bottom ring, taking care not to hit each other.

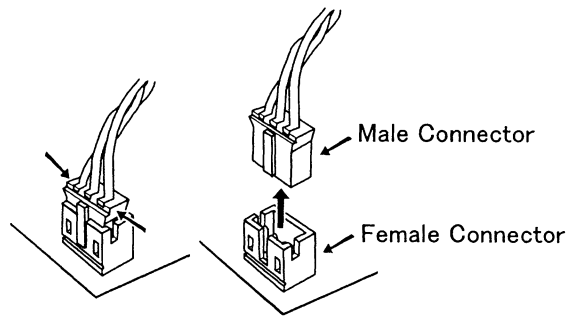
9. Attach the primary cell onto the bottom ring, taking care not to pinch the wires between the primary cell and the bottom ring. Match the tapped holes of the primary cell and the bottom ring and lock them firmly with 6 M5x25 Allen bolts with the 4mm Allen wrench.

10. Remove the Drive Unit and insert unattached 2 wires. Then, lock the unit firmly with the 4 screws.

11. Finally attach the visual back.

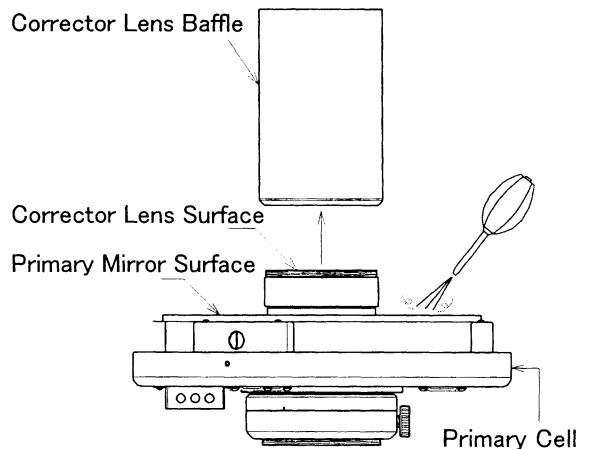
● How to detach the connector

When the male connector is detached from the female one, hold the arrowed part and pull it out as illustrated.



● Cleaning the Corrector Lens

The corrector lens installed in the primary mirror section will not be detached from the visual back side. The surface at the visual back side can be cleaned from the visual back side, removing the CAA. The surface at the secondary side can be cleaned, removing the corrector baffle. Be careful not to drop the lens baffle on the primary mirror.

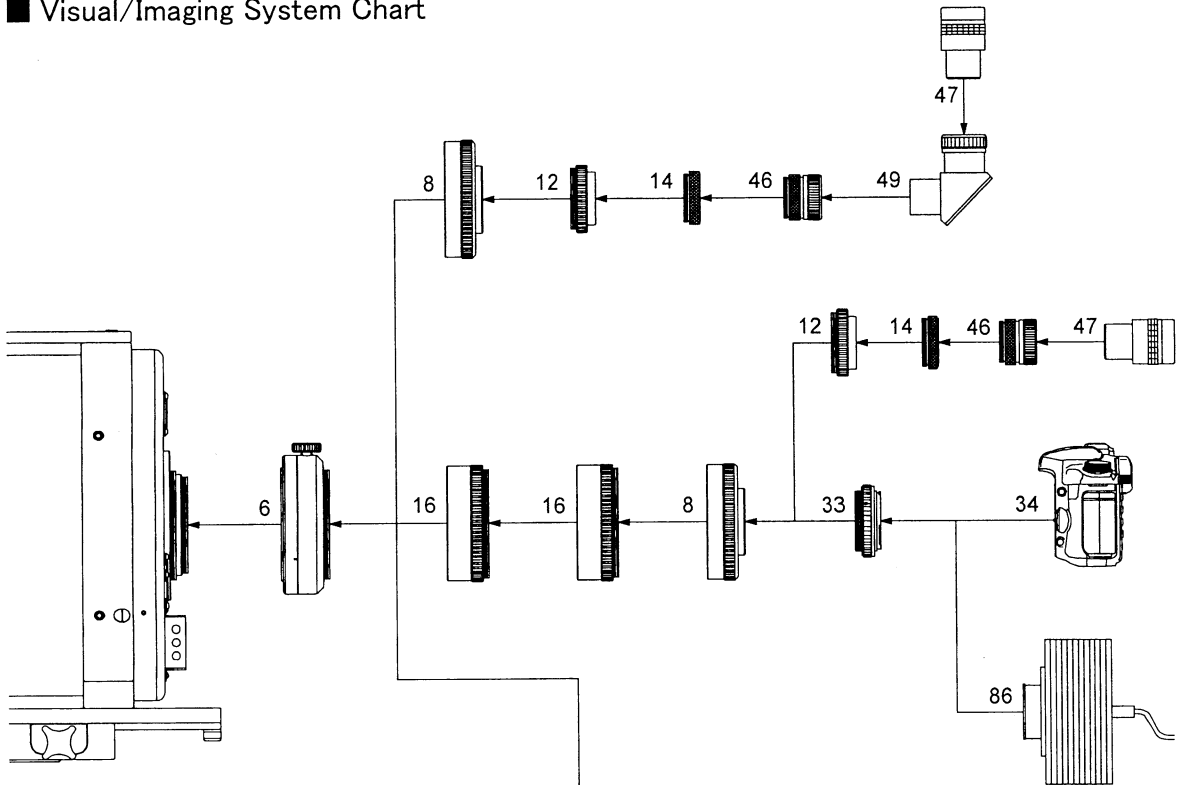


● Cleaning and Maintenance for Primary Mirror

The mirror surface of a reflector is coated with aluminum. The coating is so delicate that tiny scratches are easily given. Therefore, we do not recommend users to clean the mirror himself. Our warranty do not cover accidental scratches on the mirror when cleaned by users. When the mirrors are covered by dust particles or weathered in white, contact your local distributor who can take necessary actions for cleaning and maintenance.

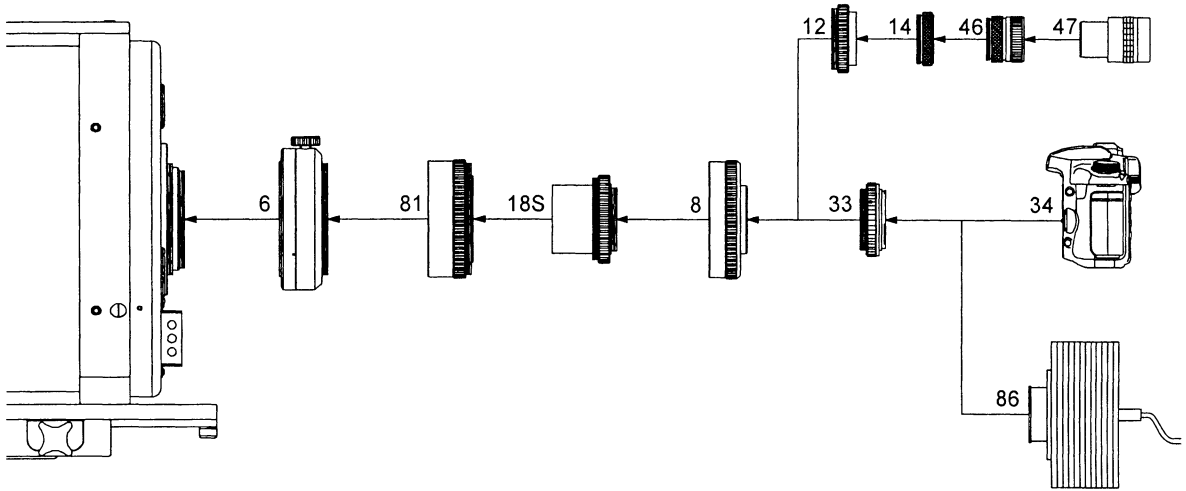
System Chart

■ Visual/Imaging System Chart



- 6. CAA [KP86200]
- 8. Coupling (TW) [TKP86003]
- 12. Visual adapter [TKP86005]
- 14. Coupling (S) [TKP00103]
- 16. Aux. ring (PF) [TKP83002]
- 18S.Reducer-CR 0.73X [TKA82580]
- 18L.645 reducer-CA0.72X [TKA86580L]
- 33. Wide T-mount DX-WR(EOS) [TKA01251]
Wide T-mount DX-WR(Nikon) [TKA01255]
- 34. DSLR camera (Canon EOS, Nikon)
- 46. 31.7(1 1/4") Ocular adapter [TKP00101]
- 47. LE oculars [TKA00520] - [TKA00528]
- 49. Diagonal prism (31.7/1 1/4") [TKA00541]
- 60. Extender-CR 1.5X [TKA82595]
- 81. RD-EXT coupling [TKA86205]
- 86. CCD

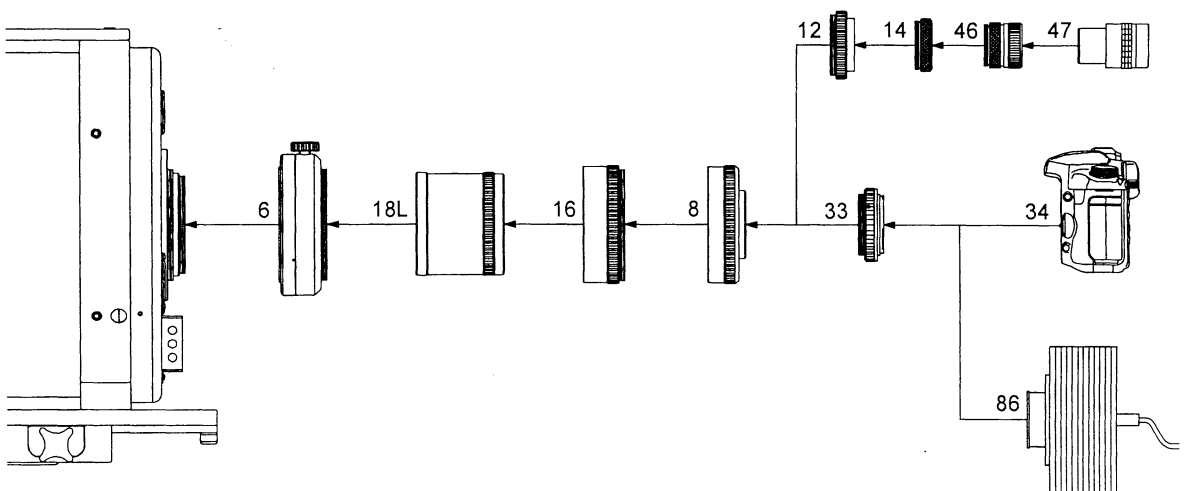
■ Reducer-CR 0.73X System Chart



- 6. CAA [TKP86200]
- 8. Coupling (TW) [TKP86003]
- 12. Visual adapter [TKP86005]
- 14. Coupling (S) [TKP00103]
- 16. Aux. ring (PF) [TKP83002]
- 18S.Reducer-CR 0.73X [TKA82580]
- 18L.645 reducer-CA0.72X [TKA86580L]

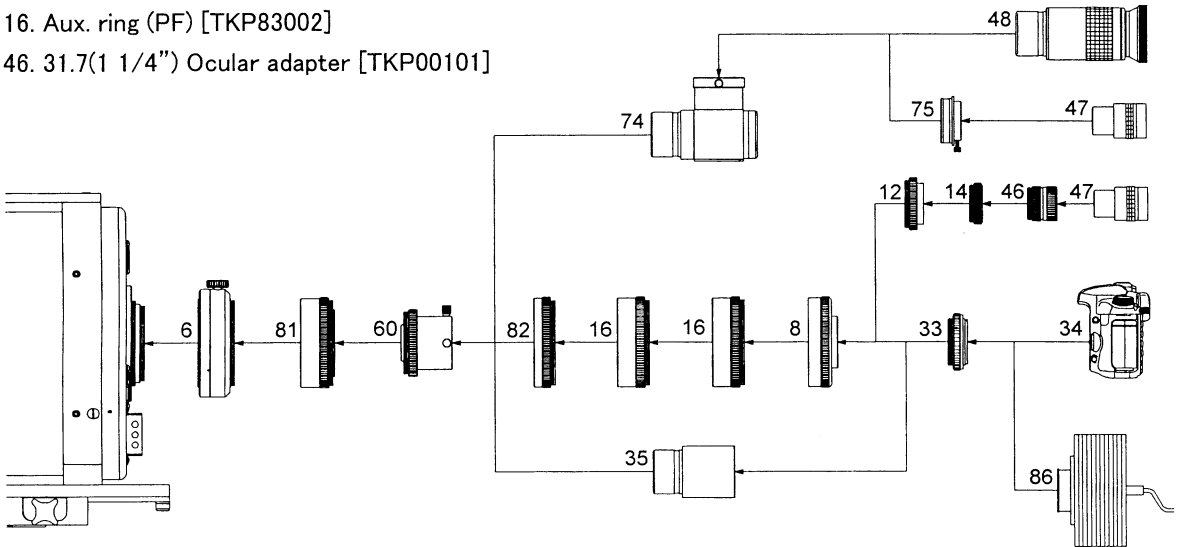
- 33. Wide T-mount DX-WR(EOS) [TKA01251]
Wide T-mount DX-WR(Nikon) [TKA01255]
- 34. DSLR camera (Canon EOS, Nikon)
- 46. 31.7(1 1/4") Ocular adapter [TKP00101]
- 47. LE oculars [TKA00520] - [TKA00528]
- 81. RD-EXT coupling [TKA86205]
- 86. CCD

■ 645 Reducer-CA System Chart



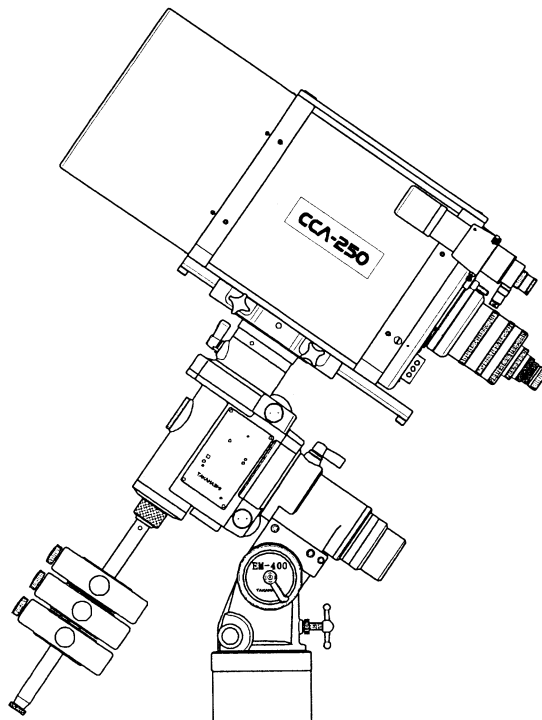
■ Extender — CR 1.5X System Chart

- 6. CAA [TKP86200]
- 8. Coupling (TW) [TKP86003]
- 12. Visual adapter [TKP86005]
- 14. Coupling (S) [TKP00103]
- 16. Aux. ring (PF) [TKP83002]
- 46. 31.7(1 1/4") Ocular adapter [TKP00101]



- 33. Wide T-mount DX-WR(EOS) [TKA01251]
Wide T-mount DX-WR(Nikon) [TKA01255]
- 34. DSLR camera (Canon EOS, Nikon)
- 35. CA-35(50.8) [TKA31201]
- 47. LE oculars [TKA00520] – [TKA00528]
- 48. LE-50mm ocular [TKA00530]
- 60. Extender-CR 1.5X [TKA82595]
- 74. Diagonal mirror (50.8/2") [TKA00543]
- 75. Adapter (DM) [TKA00111]
- 81. RD-EXT coupling [TKA86205]
- 82. Aux. ring (EXT) [TKA86596]
- 86. CCD

MEMO



TAKAHASHI SEISAKUSHO Ltd.

41-7 Oharacyo Itabashi Tokyo 174-0061, JAPAN
PHONE: +81-3-3966-9491 FAX: +81-3-3966-9524