ε-130D

Hyperboloid Flat-field Astrograph

Instruction Manual

TAKAHASHI

The ε-130D has similar specifications to the original ε-130 with respect to the aperture and focal ratio with updated optics to take advantage of digital imaging. The image circle which will cover a full frame digital SLR has stars that are 10 μm or less in size. The ε-130D for digital produces the same size stars as the ε-180. Please read this manual in order understand and use the instrument to the limit of its capabilities. This telescope has been checked and collimated at the factory by highly trained personnel. Please carefully check all parts and if there is any problem, immediately contact your local dealer

WARNING

NEVER POINT THE TELESCOPE TOWARDS THE SUN OR VIEW THE SUN THROUGH IT. THIS WILL CAUSE INSTANT BLINDNESS OR SERIOUS DAMAGE TO THE EYE. THIS TELESCOPE IS AN ASTROGRAPH AND IS MEANT TO BE USE AT NIGHT ONLY.

CAUTION

- **When attaching the telescope to a mounting carefully place the tube into the tube holder and tighten the tube clamp.**
- **The telescope should be placed on a flat surface like a table to keep it from falling to the ground and causing damage**
- **Please keep the tube assembly out of direct sunlight**
- **When focusing be careful not to pinch a finger**
- **Keep small children away from the scope and the small parts which could be swallowed**
- **The carton that the telescope was shipped in contains flammable materials. Do not place it near any heat source and keep children away from the bag that holds the OTA**

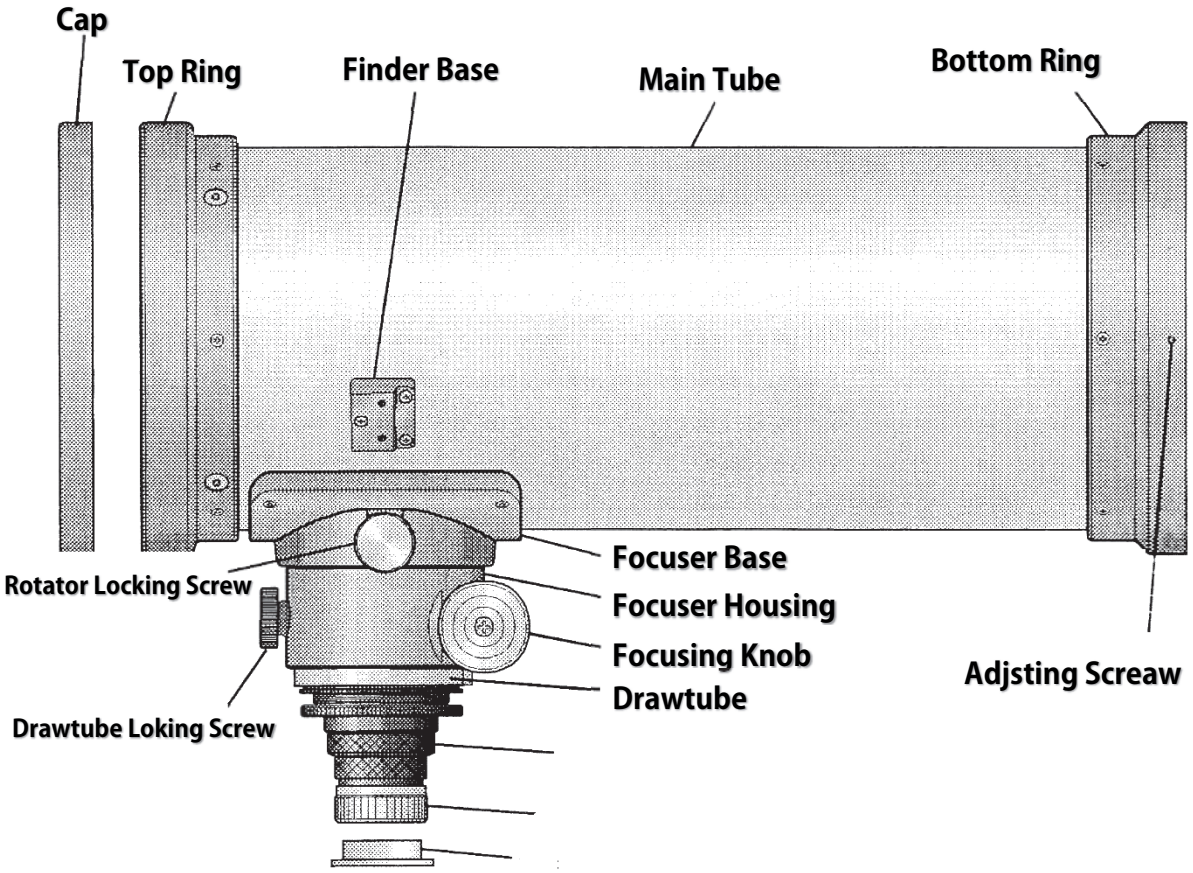
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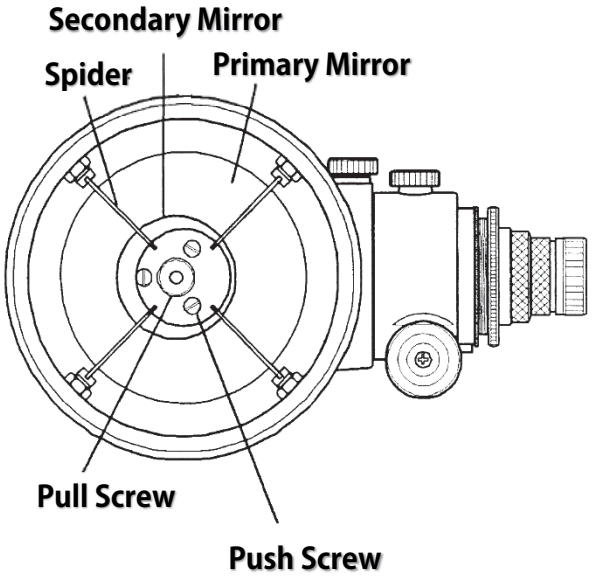
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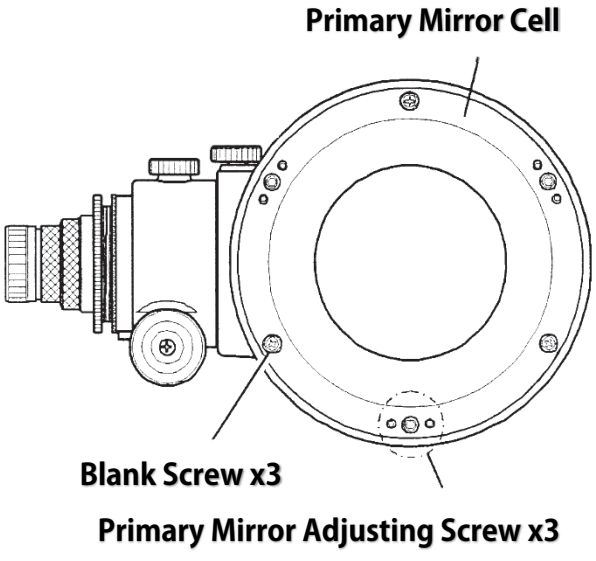
SPECIFICATIONS

Optical System	Hyperboloidal Catadioptric
Effective Aperture	130 mm
Effective Focal Length	430 mm
Effective Focal Ratio	1:3.3
Secondary Mirror Diameter	63 mm
Corrector lens	2-element
Image Circle	φ44 mm
Photographic Field	5.9 degrees
Metal Back	56 mm
Diameter of Main Tube	166mm
Length of Main Tube Ass´y	460 mm
Weight of Main Tube Ass´y	4.9 kg (10.8 lbs.)
Focusing System	Rack & Pinion <correspondence with MEF-3>
Standard Accessory	This Instruction Manual
	WARRANTY SYSTEM AND WARRANTY
	Allen Wrench (2, 2.5, 3, 4 mm)
	Three Small Screws (for Attaching and Detaching Primary Mirror)

Tube Assembly Layout







What is the ε-130D?

■Optical System

Newtonian reflector cannot produce a flat field like a four element Pezval refractor for imaging. A hyperbolic primary with a flat - field corrector can produce a field that is also free from spherical aberration and coma. This system is called the ε Series by Takahashi.

■ε Optical System in Digital Age.

The ε-130D uses an advanced corrected hyperbolic optical design. The newly designed doublet corrector produces an image circle that will cover full frame DSLR and CCD cameras with a stellar size of under 10 μm across the entire field. The image size is comparable to the ε-180ED. The spot size in the center of the field is 1/3rd small than the original ε-130. The original four element corrector did not have the ability to cover a full frame image like the ε-130D does. The Effective Focal Ratio of f/3.3 produces a 5.9° image at 430mm. The OTA weighs only 10.8 lbs. and is perfect to transport anywhere in the World. The ε-130D is a high performance optical system.

■Takahashi Mirror Making Technology

Takahashi has been producing hyperbolic mirrors about 30 years. They have improved their production procedure to produce the highest quality hyperbolic primary mirrors. Now the ε-130D has evolved into one of the most modern optical systems in the telescope industry.

■Secondary Mirror Offset

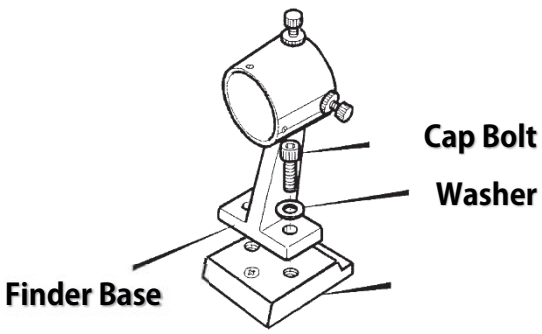
In order to achieve the maximum illumination, the secondary mirror must be offset from the primary mirror optical axis to produce the best possible illumination for the image. As the speed of the optical system increases, so does the offset. The oversized secondary mirror has been offset to produce the maximum illumination for the image.

Attaching the Finder and Tube Assembly

The ε -130D can be equipped with optional 6x30 and 7x50 finders. If purchased with the scope the finders are shipped in a separate box with the OTA. Use the following instructions to assemble and attach the finders.

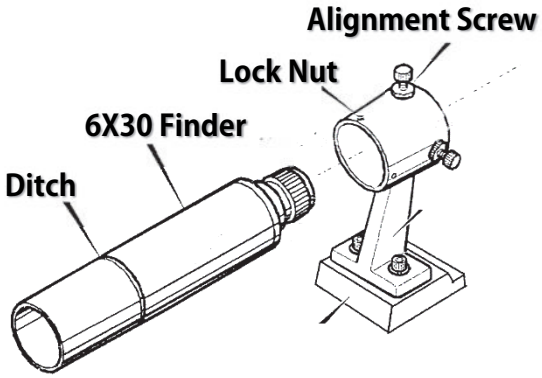
■Attaching the Finder

Attach the finder bracket using the 5 mm x 1.5 as illustrated in right figure. Do no screw in the bolts with the finder bracket since they will bottom out in the end of the tapped hole.



• 6x30 Finder

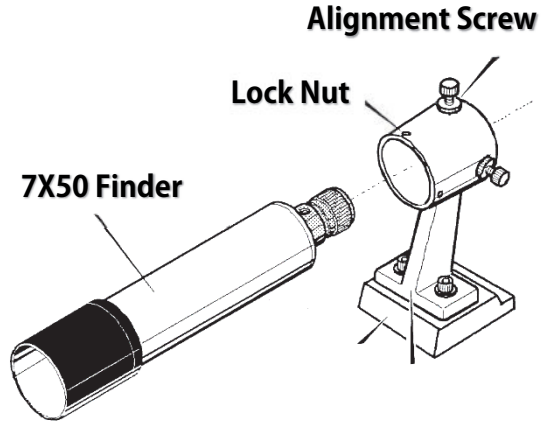
Insert the finder into the bracket and hold the finder as parallel as possible to the tube assembly when the finder bracket screws are tightened around the finder. This will make alignment easier.



• 7x50 Finder

Insert the finder for an infinity target during the day and lock the rear screws with the lock nuts and make certain that the front set of screws are in firm contact with the body of the finder.

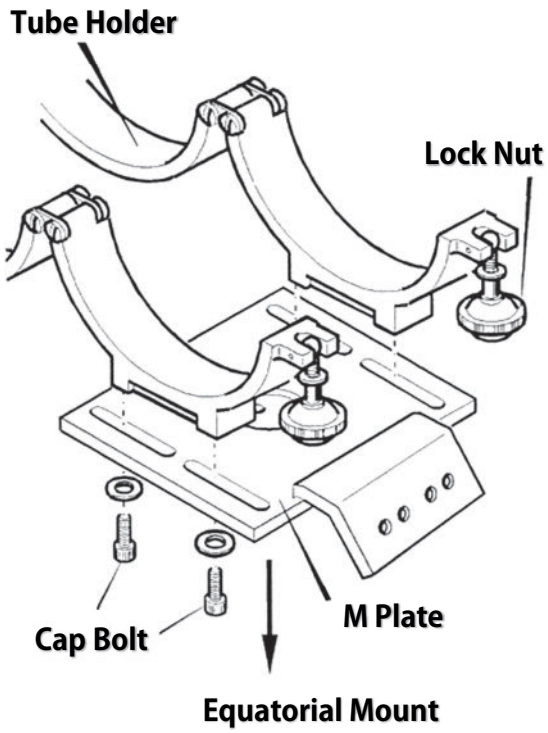
Note that the chrome screw near the eyepiece is removed to insert he optional reticle illuminator.



CAUTION: Never use the finder and bracket as a handle lift the tube. This will cause the finder o loose its alignment and could cause damage to the bracket holding the finder to the tube.

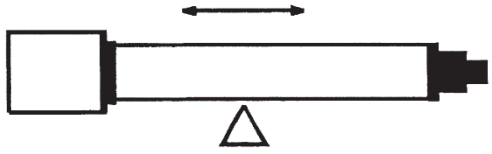
■Attaching the Tube Holder

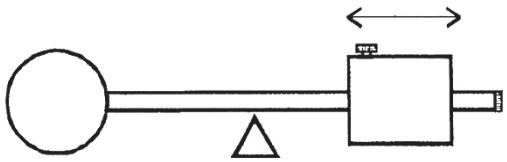
Attach the tube holder to the M-plate with the bolts provided and do not tighten them too tightly, but center the holder in the bracket. Turn the Dec. axis until the base of the plate is parallel the ground and lock the axis. M-plate is directly attached on our product of EM-200 or EM-400 equatorial mount. When the NJP or EM-500 mount is used, attach the optional band adapter which converts the mounting plate to the 2-hole pattern used with the M-plate. We can provide our product equatorial mounts which can be used according to the purpose of application. Especially in case of constellation, nebula and cluster photography, larger mounts provide a more stable platform for the ε-130D.



■Balancing

Place the ε-130D into the holder and tighten the clamps to the point where the telescope is held, but still can be slide forwards or backward for balance. Then, unlock the Dec. clamp but hold the telescope with one hand for safety. Balance the tube assembly and lock the Dec. clamp and then attach all the equipment to be used to the tube. Turn the tube to place the imaging equipment in the direction opposite to the Dec. axis. While holding the scope release the Dec. clamp and slide the tube in either direction to balance the scope and the imaging package used. Then unclamp the R.A. but hold on to the OTA. Move the counter weights on the shaft until the instrument is balanced in any position it is moved. Further, when imaging begins it is a good idea to balance the instrument and camera in the arc in which it will be used to image. This insures superior tracking.





■Focusing System

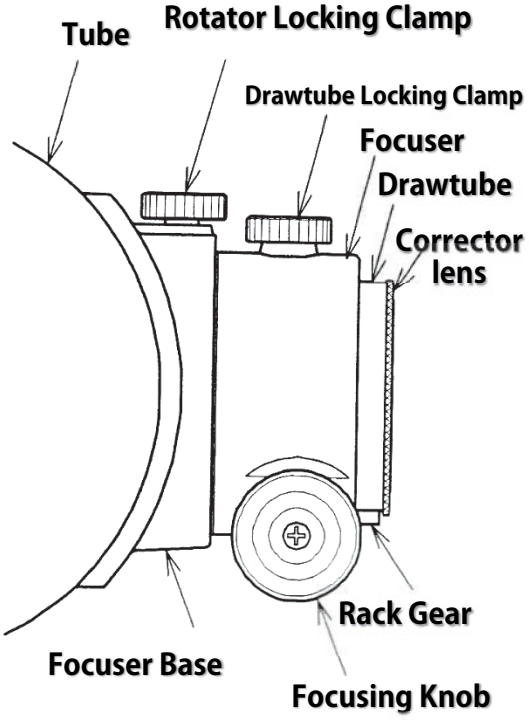
The ε-130D uses a rack-pinion type focusing system. This system permits rapid focusing. After loosening the drawtube clamp by turning counter clockwise the focuser can be moved in or out. Be certain that the lock screw is loosened to prevent damage to the rack.

■Corrector Assembly

The ε-130D utilizes a two element digital corrector which is mounted in a cell which is attached to the focuser draw tube. This corrector is always used when imaging and removed when the ε-130D is collimated. Consult the system chart on page 26 for reference.

■Camera Angle Adjuster

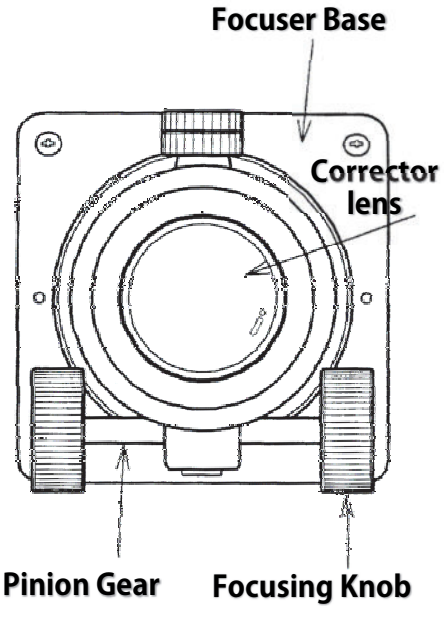
The ε-130D is focuser is equipped with a camera angle adjuster [camera rotator] that allows 360° rotation of the imaging camera. This rotator permits precise framing of any image. Loosen the rotator locking clamp to allow the focuser to rotate and tighten this lock when the desired framing is achieved. When using the camera angle adjuster have a firm grip on the imaging package as it is moved.



■Visual Use

The ε-130D at f/3.3 due to the large size of the secondary can be used with eyepieces 18mm or shorter focal length and the 430mm focal length allows for wide field viewing if desired. A 31.7 compression visual adapter is included as standard equipment with the ε - 130D.

Takahashi manufactures the LE, UW and Abbe Series 31.7 eyepieces all of which can be used on the ε-130D



■Oculars

The following oculars are available from Takahashi. Use them in the best way.

●LE Oculars

A wide selection of wide field oculars are available from 5mm to 50mm focal length.

LE5, LE7mm: Alternatively φ31.7 mm and φ24.5 mm

LE10, LE12.5, LE18, LE24, LE30mm: φ31.7 mm

LE50mm: φ50.8 mm

●Hi LE Oculars

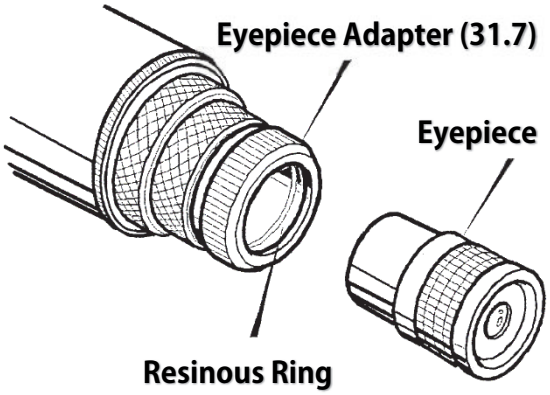
Hi LE-2.8mm and Hi LE-3.6mm are available for planet observation. ε-130D is suited to lower magnification observation. The usage of these eyepiece should be the finder adjustment. These sleeve size can alternatively employ φ31.7 mm and φ24.5 mm.

●TAK-UW

This eyepiece appearance field of view is about 90 degrees. The special feature is the sharp star image in all the field of view. The sleeve size can employ φ31.7 mm.

●Abbe

This simple eye piece is quad lens, lower ghost, higher contrast and lower price, but this eye piece is a narrower appearance field of view. The sleeve size can employ φ31.7 mm.

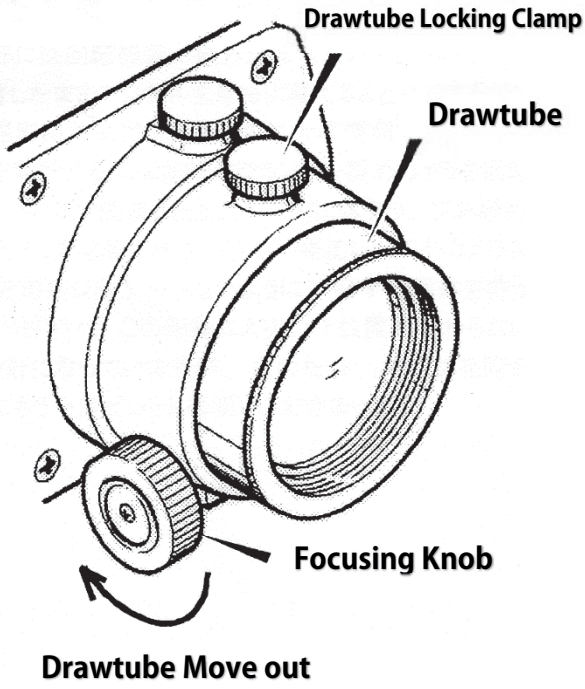


■Focusing

After inserting the imaging package the ε-130D can be focused using the focus knobs, MEF fine focuser or electronic focusing system attached to the focuser, the electronic focuser being the most precise.

●Focusing System

When the focus knob is turned in the direction of the arrow the draw tube will move out and will move in when the knob is turned in the opposite direction. Refer to the illustration below.



●Focus Clamp

A focuser clamp is included with the focuser to lock the focuser when precise has been achieved and loosen to change the focus.

Finder Alignment



Before the finder is placed in the finder holder, use plastic clear tape and tape the finder with two layers to prevent the tube from being scratched by the front finder setscrews.

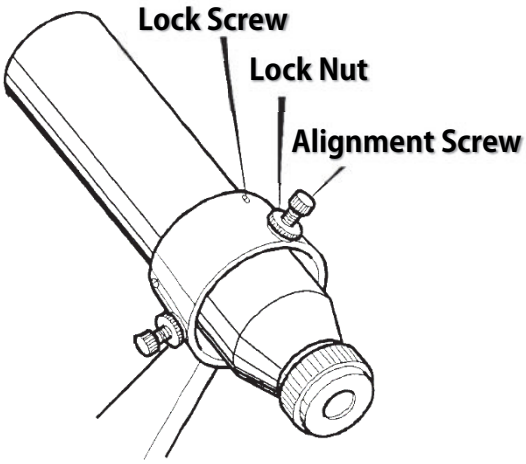
A finder is a useful tool. It permits the precise centering of an object in the field of view. The 8 or 6.3 degrees field of view allows the easily centering of an object to be viewed or photographed.

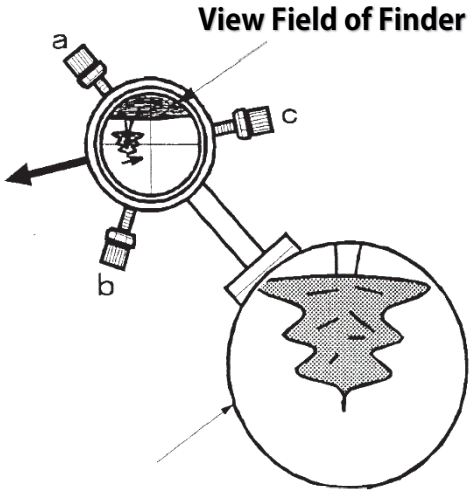
The Takahashi finder uses an interrupted crosshair which is designed to allow the easy centering of an object to be photographed or observed. The wide field of the finder makes the finding of an object easier, therefore, it is important that the finder and the telescope be in alignment. The following procedure can be used to align the finder.

◆Alignment Procedure

1. Place a low power eyepiece in the telescope and center a bright star in a convenient part of the sky. Do not forget to engage the motor drive to keep the star centered. If this procedure is done in daylight, use an object that is at least one mile away. Loosen the lock nuts on the finder bracket and slightly move the star to the center of the field using the adjusting alignment screws.

2. Then use a higher magnification eyepiece and repeat the procedure by centering the object in the field of view of the telescope and then the finder. Continue this process until the highest possible magnification has been used.





◆Adjusting Screw Procedure

1. Turn all the lock nuts until they reach the head of the alignment screws.
2. 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 desire direction. The top of the finder will move in the opposite direction and the object will move in the direction of the smaller arrow.
3. In a similar fashion the direction of the movement of the finder is made by adjusting the three screws.

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.

◆Reticle Illuminator (Optional)

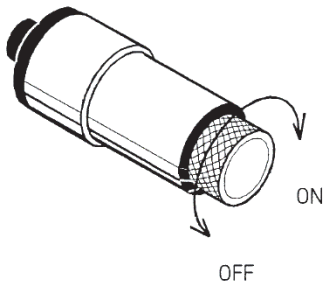
The 7x50mm finder has provision or an optional reticle illuminator. If an illuminator will be installed, remove the cap screw at the end of the finder and install the reticle illuminator. The illuminator makes the centering of dim objects easier.

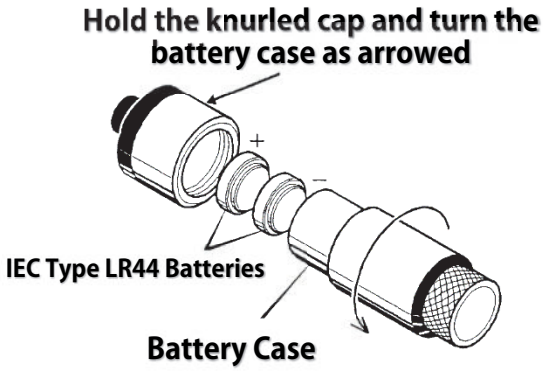
In order to turn the illuminator on, turn the knob clockwise. The knob will click when the illuminator turns on. As the knob is turned, the reticle will brighten. Adjust the knob to the desired brightness. Turn the knob counter-clockwise past the click to turn the illuminator off.

◆Replacing The Battery

Before changing the batteries in the illuminator, please be certain to turn it off. Unscrew the battery holder as shown in bottom figure.

Remove the old batteries and insert new one after they have been wiped with a clean dry cloth. Check the polarity of the batteries before inserting hem into the holder. Use two IEC Type LR44 batteries or equivalent batteries.





Observation

■Cool Down

The ε-130D uses an oversized φ166 mm primary which requires a cool down period for the temperature of the primary mirror to equalize with the outdoor temperature. This is especially true in the colder winter.

It is advisable to take the instrument out about one hour before it intended use to insure temperature equalization.

■ Visual Observation

◆ Determining Magnification

The ε-130D is designed to be a flat-field astrograph and as a result uses an oversized secondary to provide illumination. This larger secondary limits the focal length of the lowest power used to a 23mm or shorter focal length eyepiece at 18.7x. This eyepiece will provide the maximum field size. Any longer focal length will cause vignetting of the field caused by an oversized exit pupil.

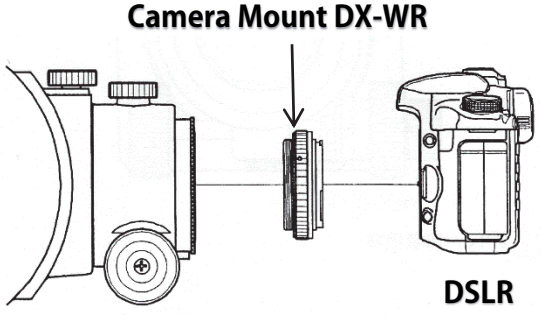
■Astro Imaging

Critical focus must be achieved to produce a flat field image with pinpoint stars the ε-130D was designed to produce. This critical focus should be checked with each new image.

◆Prime Focus imaging

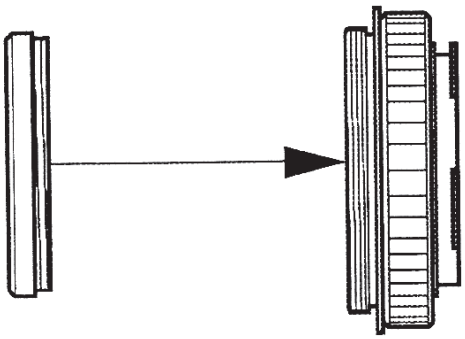
The ε-130D is designed to be used at f/3.3 and consequently has a very narrow depth of field; this is a principle of optics. Therefore, a fine focusing mechanism or a computer controlled electronic focuser will enable the ε-130D to produce the 10μm stars.

The ε-130D has been designed to be used with a DSLR or CCD camera. The output thread is ∅ 55mm x.75 output wide mount T-thread. There are a number of wide mount adapters that allow the ε-130D to be used with a DSLR or CCD camera. The wide mount camera adapters cover all popular brands and the customer adapter accept a number of CCD cameras.



◆Filters

When a filter is used such as the 48mm for the wide mount adapter or any other filter, the spacer should by shortened by 1/3rd the thickness of the filter because the introduction of the filter into the light path has increased the glass path distance by 1/3rd the thickness of the filter used



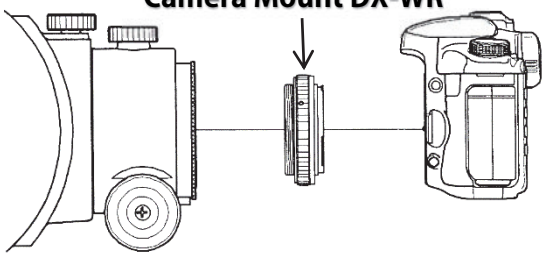
48 mm filter **Camera Mount DX-WR**

Photographic Accessories

Dedicated accessories are available for attaching a camera to the ε-130D

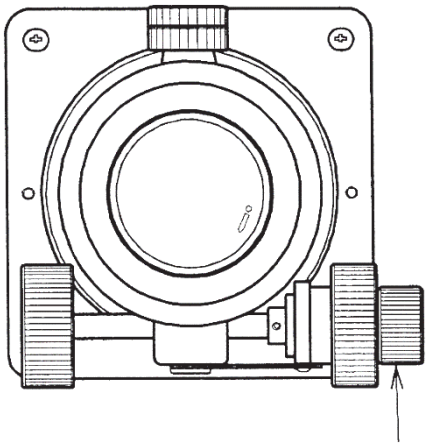
■Wide Mount Camera Adapters DX-WR

The Takahashi wide-mount camera adapter is designed to take full advantage of a fully illuminated 35mm frame. It is φ 55 mm so as not to cause vignette of the image circle produced by the ε-130D. This wide mount adapter is available for Nikon, Cannon and other brands by request.



■MEF-3 (Optional Accessary)

The optionally available MEF-3 8 to 1 micro focuser can be attached to the ε-130D for more precise focusing of the image.



Collimation of the ε-130D

The ε-130D is precisely collimated before shipment. In the event it is received decollimated, contact your local dealer to arrange for return for proper collimation. In time it might become necessary, after continual use, to recollimate the telescope. The collimation procedure is explained below

■ Collimation Tool List

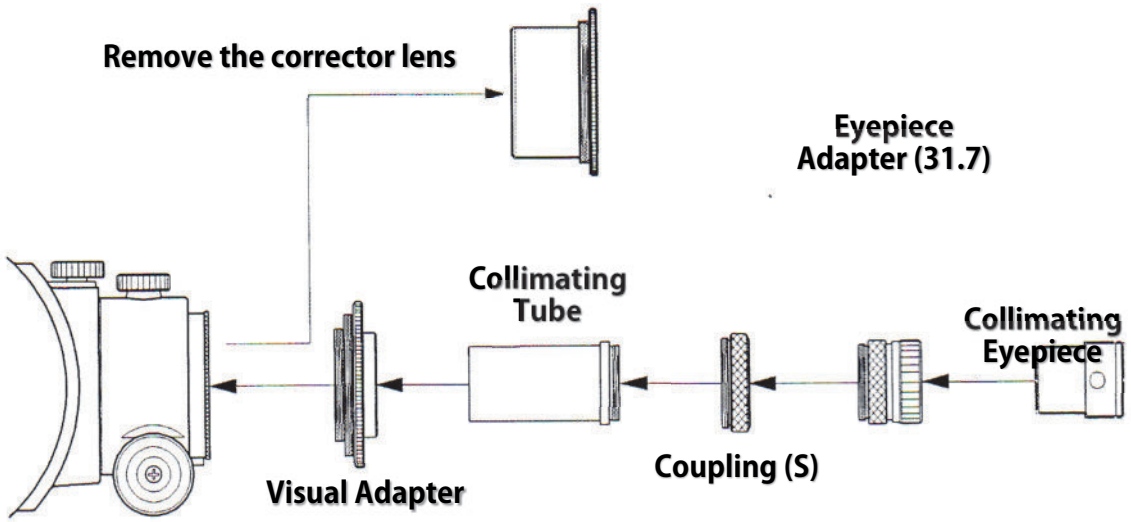
Accessory and Tool in ε-130D

- **Visual Adapter(ε-130D) [TKP69005]**
- **Coupling（S) [TKP00103]**
- **Eyepiece adapter (31.7) [TKP00101]**
- **Allen Wrench 2.0 mm**
- **Allen Wrench 2.5 mm**
- **Allen Wrench 3.0 mm**
- **Allen Wrench 4.0 mm**

Optional Tool (at extra cost)

- **Collimating Tube 31.7 [TKA00442]**
- **Collimating Eyepiece [TKA00441]**
- **Flathead Screwdriver**
- **Adjustable Wrench (capable of 14 mm hexagon headed bolts)**

Lock the camera angle adjuster knob, and then remove visual adapter and then the corrector. The corrector assembly must be removed in order to collimate the ε-130D.



■ Preparation of Telescope

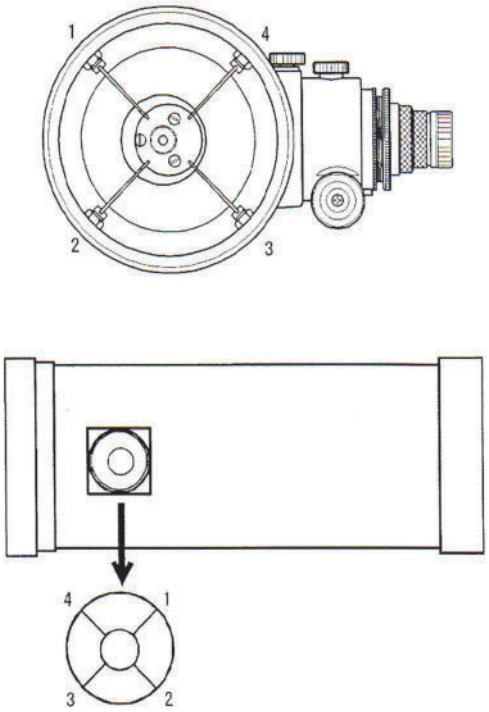
Using the collimating eyepiece and collimating tube will be a great help in collimating the ε-130D. The collimating tube has a provision for the insertion of a crosshair. Use nylon thread pulled together taught and our small pieces of tape to score the crosshair. Then these stands can be glued for a permanent set up. When collimation is necessary, a process that is done during the day in a bright lit room; the telescope can be pointed at a brightly lit white wall or at a translucent white sheet laid across a window. Place the tube with the focuser to the left as facing the light source. The figure illustrates the set just described. (It is suggested that if possible you attach the ε-130D to the mount. This will make pointing and leveling the OTA and pointing it towards the light source simple.) If you lose your orientation to the movement of the secondary mirror, place your finger over the opening of the tube to regain your orientation. The directions of the field of view correspond to the numbers 1 through 4 on the illustration.

■Adjusting the Secondary Mirror

The secondary mirror can be tilted for collimation by slightly loosening the large securing nut in the center of the secondary assembly. Then the three tilting screw can be adjusted after which the securing nut should be tightened to hold the adjustment.

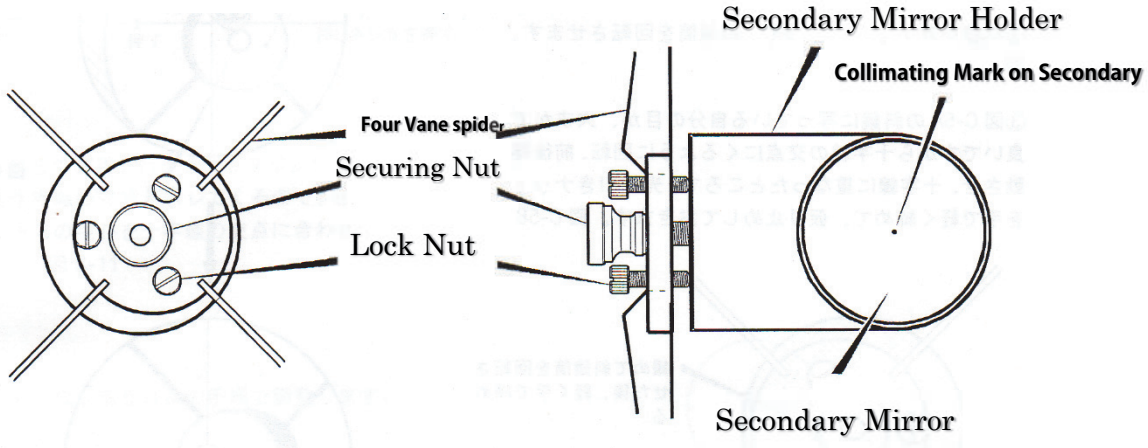
○ Collimating Mark on Primary

· Collimating Mark on Secondary



■Collimating Marks

In order to allow the ε-130D to be more easily Collimated, collimating marks have been placed on the primary and secondary mirrors.



■Secondary Mirror Operation

1. Turning the Secondary Mirror

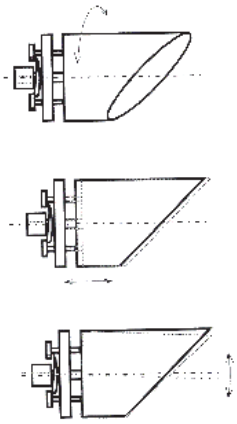
Loosen the large securing knurled nut which holds the secondary mirror assembly to the spider slightly by turning it counter-clockwise. This will allow the secondary mirror to be turned in either direction and then tightened by turning the nut clockwise. When the securing nut is loosened, loosen the nut very sparingly to allow the secondary mirror to be turn, but not too loose.

2. Moving the secondary mirror

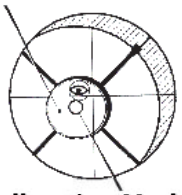
Loosening the large knurled knob some distance will allow the secondary to be move up or down in a parallel fashion for better collimation.

3. Tilting the Secondary Mirror

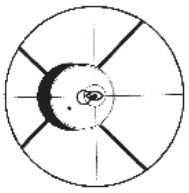
There are three screws with locking nut provided to allow the secondary mirror to be tilted for collimation. In order to tile the secondary mirror, it is necessary to loosen the lock nuts. Loosen each slightly to prevent the secondary mirror from moving too much.



Collmating Mark on Secondary



Collmating Mark on Primary

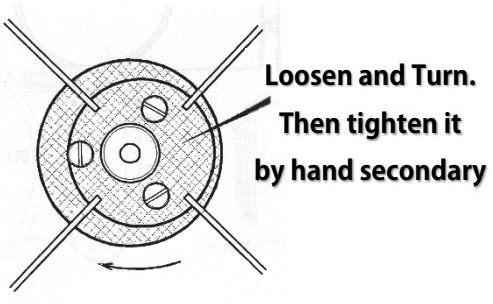


◆Aligning the Secondary Mirror

① Turn the crosshair of the collimating eyepiece so that one set of lines is parallel a he ground which would make the second set of lines is parallel to the optical axis of the tube which would make the secondary set of lines perpendicular. The diagonal holder is provided with three tilting screws with lock nuts to allow the secondary to be tilted for precise collimation Make certain that the telescope is pointing at the white card or a window with a translucent curtain on it. In the event the secondary is rotated out alignment follow the next step. One set of lines parallel to the optical axis of the tube.

② Loosen the large knurled nut holding the threaded rod of the secondary mirror holder and turn the secondary.

③ Rotate the secondary until your eye reflected in the diagonal as it is centered in the crosshair. When the reflection of your eye in centered in the crosshair, slightly tighten the knurled nut.



④ Insert the collimating eyepiece and tilt the secondary mirror until the dot on the surface in over the center of the cross hairs. In the illustration Fig. C-7, the center of the collimating eyepiece matched the center of the crosshair, but the secondary mirror dot is located low and to the left. The secondary mirror must now tilted toward the primary mirror mark (+) and the (+) must be moved upwards. Slightly loosen the push screw A, B C after backing off the lock nuts. Loosen the large knurled nut in the center and tighten the push screw A, B and C. Refer to the Figs. C-8 and C-9.



Opening View of the Collimating Eyepiece

Fig. C-6

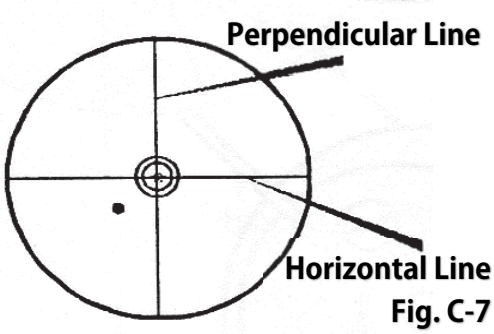
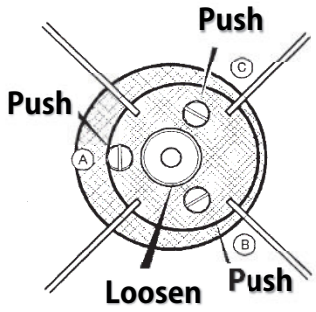


Fig. C-7



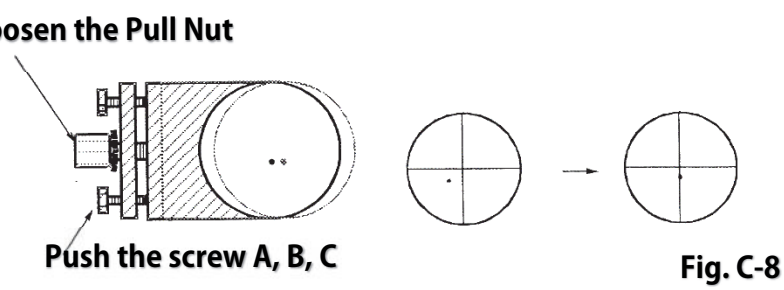
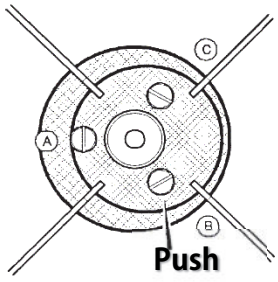


Fig. C-8



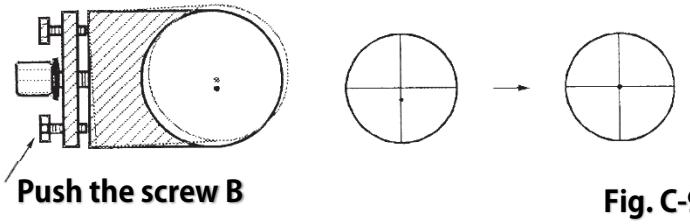
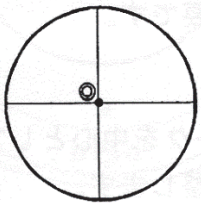


Fig. C-9

⑤ Now the center dot of the secondary has been shifted below the center of the crosshairs. It then becomes necessary to tilt the secondary using screws A, B and C to center the dot on the secondary mirror with the center of the crosshairs.



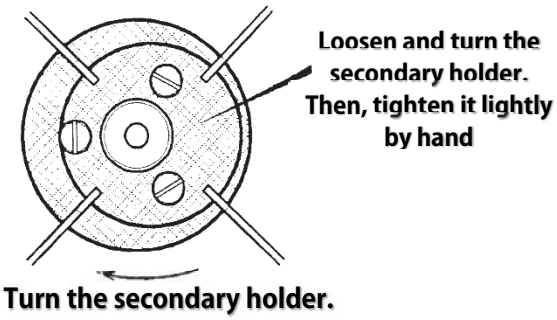




Fig. C-10

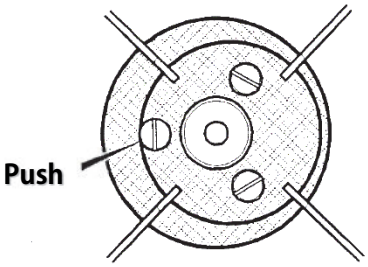
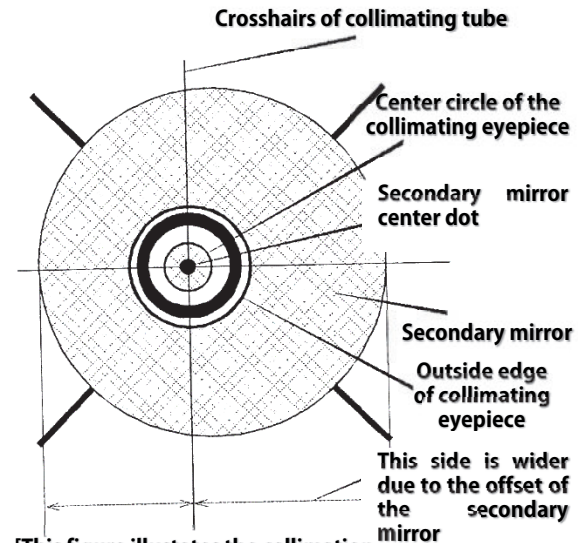




Fig. C-11

⑥ In this process the center of the reflection of the collimating eyepiece has been shifted off center as seen on the Fig. C-10. Then it becomes necessary to rotate and tilt the secondary mirror so that the center of the reflection of the collimating eyepiece in center on the crosshairs. In the Fig. C-10 the secondary mirror is rotated so that the reflection on cross hair and in the Fig. C-11 the secondary mirror is tilted so that the center reflection of the collimating eyepiece in centered on the crosshairs by tightening push screw A. Now the center reflection if the collimating eyepiece is centered over the crosshairs as well as the center dot on the secondary mirror.



[This figure illustates the collimation of the correct secondary mirror.](Note: In this illustration the circle on the primary mirror has been left out.

Fig. C-12

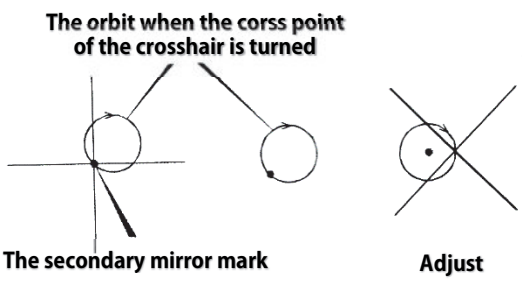


Fig. C-13

◆Collimating the Primary Mirror

⑦As you look through the collimating eyepiece you will notice that the circle on the primary mirror is not centered on the reflection if dot on the surface of the secondary mirror and the collimating eyepiece. It is now necessary tilt the primary to center the circle on dot placed on the secondary and the collimating eyepiece pattern.

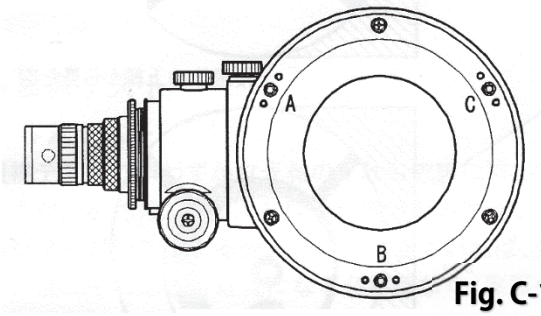


Fig. C-14

You will use 14 mm open end wrench supplied and a large screw driver.
Look at the illustration of the rear of the mirror cell. You will note that the three collimating screw sets are labeled counter-clockwise A, B and C.

Please study the illustration of the cross section of the collimating screw sets. The illustration shows the pull screw which is the screw at the center with the large slotted knurled head, the lock nut and the push screws. The push screw is adjusted by loosening the lock nut and turning the push screw with the 14 mm open end wrench. The center pull screw is also used to attach the mirror cell to the rear of the telescope and is adjusted with a large balanced screw driver.

Noting the location of the circle on the surface of the primary in the image of the collimating eyepiece, adjust the primary mirror.

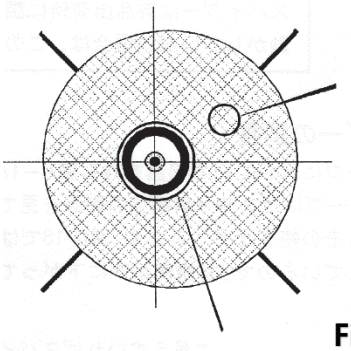


Fig. C-15

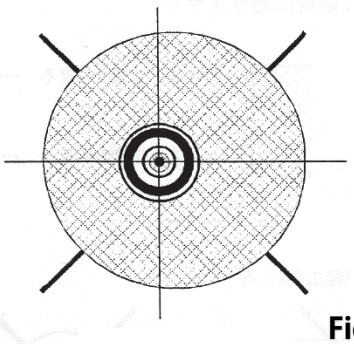
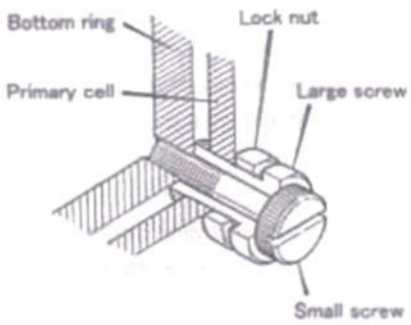


Fig. C-16





◆Adjusting the Primary Mirror

⑧It is best to have the ε-130D on the mount pointing as close to straight up as possible to use gravity to make certain that the movement of the mirror will be permanent and it will ensure that the cell is seated properly.

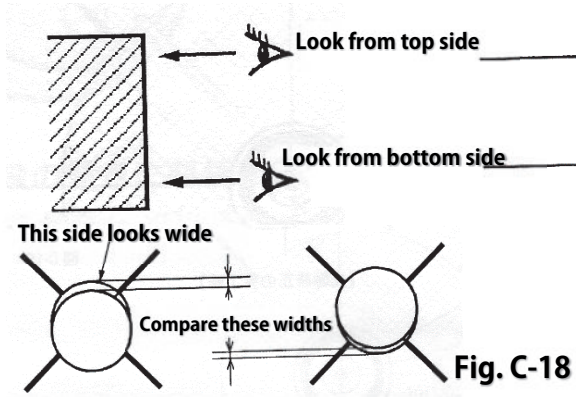


Fig. C-18

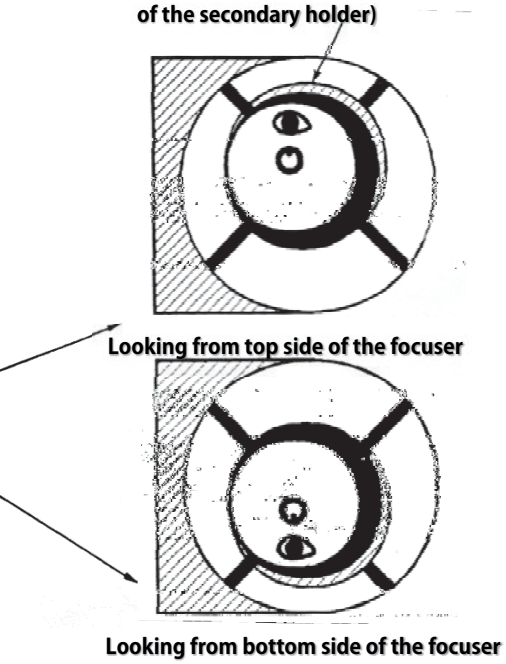
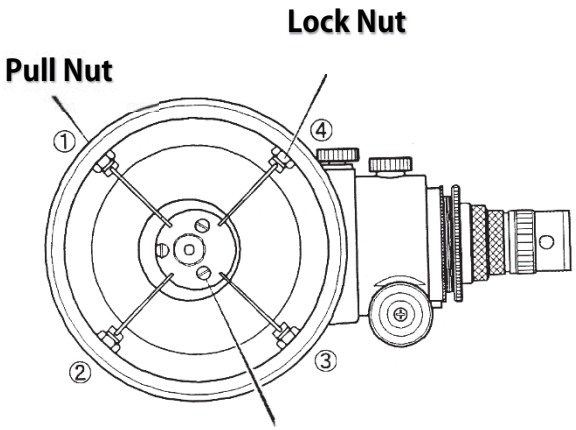


Fig. C-17

1. Loosen all the pull screws.
2. Then loosen all of the lock nuts.
3. Using the 14 mm open end wrench tilt the primary mirror so that the circle is moved to be concentric with the pattern on the diagonal reflection as seen through the collimating eyepiece.
4. Then tighten the pull screw and all of the locking nuts with 14 mm wrench. Check the image after this is done to make certain that the adjustment has been locked in place.



Push and Lock Nut for Collimation

Fig. C-19

Now, turn the focuser with the Camera Angle Adjuster. As seen in the Fig. C-13 the crosshairs will orbit around the center dot on the secondary mirror. Therefore, further fine adjustment are required.

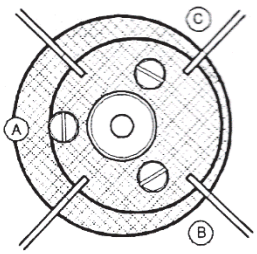


Fig. C-20

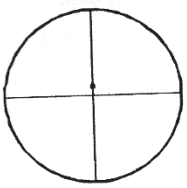


Fig. C-21

Repeat the above process. Then make certain the following.

◎ The center reflection of the collimating eyepiece is in the centered on the crosshairs of the secondary mirror mark.

◎ The primary mirror mark is in the centered cross point of four spiders.

◎ It is same width of secondary mirror edge that you look from top side of the secondary mirror and that you look from bottom side of the secondary mirror.

◆Star Imaging Test

The collimation can be tested by making an image of a bright star and looking the image. It will indicate if the collimation is spot on. If not make fine adjustments and subsequent images to test collimation until it is perfect

1. Picture Test

Because above collimating adjustment you can find out a small optical axis error, don′t mind the over or under focused image. We recommend the real picture test of star. If you look at the coma abbreviation around the picture edge, fat point, seeing double stars, then the optical axis err causes their images. Check the picture in above images, and then adjust the optical axis.

2. Visual Test

Since the secondary is an eccentric mirror, note that the diffraction ring is normally an eccentric circle in the image.

Advice for Photography

◆Getting the Best Image

Choose third or fourth magnitude star for focusing. In order to focus the star, the camera finder is invalid because the camera finder is insufficient precision for focusing. For focusing, good choice DSLR is a camera the live view display is attached. β-SGR built-in type is very good at focusing the best star image.

◆Experimentally Taking a Picture

Avoiding the light pollution, you might go to a good observation point. Before going to the point, you should experimentally take a picture for the best focusing around your home. This focusing is suitable for using effectively time at the good observation point.

◆Reference Star Guide for Photography

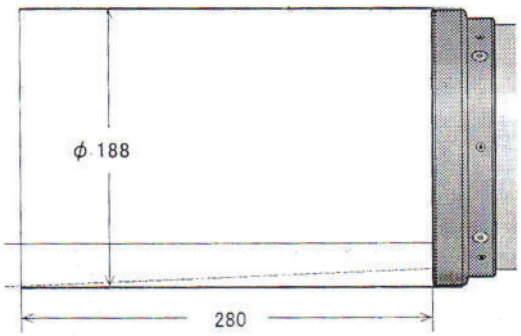
The fast optical system such as ε-130D is unacceptable for the reference star guide error. Prepare the strong mount and the precise guide telescope. You are available for Takahashi GT-40 and α-SGR3.

◆Other Notification

After deciding the composition of the picture, tighten the Camera Rotator Clamp.

◆Dew Shield

In the standard ε-130D, there is no dew shield. When you attach the dew shield to your telescope, your telescope avoids stray light and night dew. The material is a cardboard and so on. The diameter is φ188 mm and the best length is 280 mm.



Care and Maintenance

◆Primary and Secondary Mirror

When they get dew on their surface during observation or when they get moisture on the mirror after the scope is brought into warm room from cold outside, dry it immediately. Dew and moisture may cause the mirrors and fixtures get musty and dirty. When the secondary or the primary mirror get dust on it, take it out with the cell together and blow out the dust by a hand power blower. When mold or rust covers all mirror, cleaning or recoating may be required. In such case, ask your dealer what to do. A slight pressure on the mirror may cause the stellar images distorted. A great care must be taken when the cell is set in place after repairing service. Do not set the screw too tight. Sharp edge of the secondary mirror can be chipped by a shock on it. Be careful in handling.

◆Corrector Lens

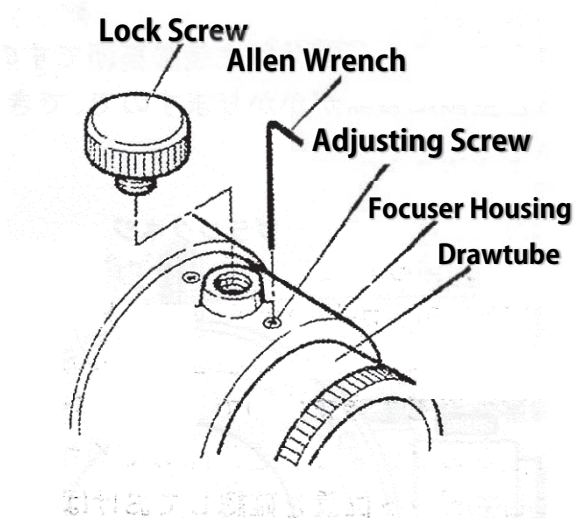
Never take out the corrector lens from its cell. It is very difficult for amateur to align the lens to keep its right performance and doing so will make warranty void. If the lens surface gets dust, take out the assembly from draw tube and blow out the dust by a hand power blower. Should it get dirt or fingerprint on the lens, wipe it gently with a swab moistened with lens cleaner, turning it from the center toward the edge.

◆Tube

Dust on the main tube can be wiped off with a duster and stained dirt on the tube can be cleaned with a car wax

◆Drawtube Moving Adjustment

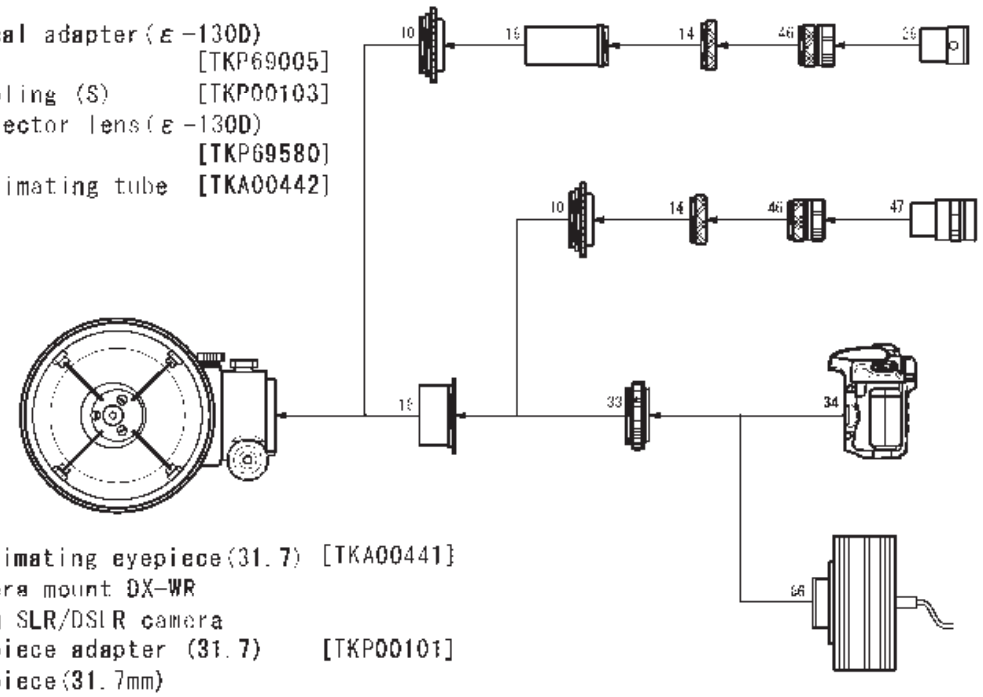
The focuser may come to be loosened after a long period if use. It can be fixed by the adjusting screws provided on the focuser as shown in the following. Be careful not to tighten the focuser too much.



ε－１３０Ｄ

Photo/Visual System Chart

10. Visual adapter(ε-130D) [TKP69005]
14. Coupling (S) [TKP00103]
18. Corrector lens(ε-130D) [TKP69580]
19. Collimating tube [TKA00442]



29. Collimating eyepiece(31.7) [TKA00441]
33. Camera mount DX-WR
34. 35mm SLR/DSLR camera
46. Eyepiece adapter (31.7) [TKP00101]
47. Eyepiece(31.7mm)
86. CCD camera

※Some 35mm SLR/DSLR cameras cannot be connected.

<<Memo>>

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