CELESTRON®



EdgeHD Series

INSTRUCTION MANUAL

EdgeHD 8 • **EdgeHD 9.25** • **EdgeHD 11** • **EdgeHD 14**

Your telescope is designed to give you years of fun and rewarding observations. However, there are a few things to consider before using your telescope that will ensure your safety and protect your equipment.

Warning



- **Never look directly at the sun with the naked eye or with a telescope (unless you have the proper solar filter). Permanent and irreversible eye damage may result.**
- Never use your telescope to project an image of the sun onto any surface. Internal heat build-up can damage the telescope and any accessories attached to it.
- Never use an eyepiece solar filter or a Herschel wedge. Internal heat build-up inside the telescope can cause these devices to crack or break, allowing unfiltered sunlight to pass through to the eye.

Never leave the telescope unsupervised, either when children are present or adults who may not be familiar with the correct operating procedures of your telescope.

	#91030-XLT	**#91040-XLT**	**#91050-XLT**	**#91060-XLT**
	EdgeHD 800	**EdgeHD 925**	**EdgeHD 1100**	**EdgeHD 1400**
Diameter	203mm (8") EdgeHD Optics	235mm (9.25") EdgeHD Optics	280mm (11") EdgeHD Optics	356mm (14") EdgeHD Optics
Focal Length	2032mm F/10	2350mm F/10	2800mm F/10	3910mm F/10
Eyepiece	40mm - 1.25" (51x)	23mm - 2" (102x)	23mm - 2" (122x)	23mm - 2" (170x)
Finderscope	9x50	9x50	9x50	9x50
Diagonal	90° - 1.25"	90° - 2" with 1.25" adapter	90° - 2" with 1.25" adapter	90° - 2" with 1.25" adapter
Technical Specs				
Highest Useful Magnification	480x	555x	660x	840x
Lowest Useful Magnification	29x	34x	40x	51x
Limiting Stellar Magnitude	14	14.4	14.7	15.3
Resolution: Rayleigh	.68 arc seconds	.59 arc seconds	.50 arc seconds	.39 arc seconds
Dawes Limit	.57 arc seconds	.49 arc seconds	.42 arc seconds	.33 arc seconds
Light Gathering Power	843x unaided eye	1127x unaided eye	1593x unaided eye	2579x unaided eye
Field of View: standard eyepiece	.85º	.8º	.67º	.48º
Linear FOV (@1000 yds)	44 ft.	42 ft.	35 ft.	25 ft.
Optical Coatings - Standard	Starbright XLT Coating	Starbright XLT Coating	Starbright XLT Coating	Starbright XLT Coating
Secondary Mirror Obstruction	2.7"	3.35"	3.75"	4.5"
by Area	11%	13%	12%	10%
by Diameter	34%	36%	34%	32%
Optical tube length	17 inches	22 inches	24 inches	31 inches

Attaching the Visual Back

The visual back is the accessory that allows you to attach all visual accessories to the 8" telescope. The 8" telescope optical tubes come with the visual back installed. If it is not already on the tube it can be attached as follows:

1. Remove the rubber cover on the rear cell.
2. Place the knurled slip ring on the visual back over the threads on the rear cell (Fig 1-1).
3. Hold the visual back with the set screw in a convenient position and rotate the knurled slip ring clockwise until tight.

Once this is done, you are ready to attach other accessories, such as eyepieces, diagonal prisms, etc.

If you want to remove the visual back, rotate the slip ring counterclockwise until it is free of the rear cell.

Installing the Star Diagonal

The star diagonal is a prism or mirror that diverts the light at a right angle to the light path of the telescope. This allows you to observe in positions that are physically more comfortable than if you looked straight through.

To attach the 1.25" star diagonal onto the 8" optical tube:

1. Turn the set screw on the visual back until its tip no longer extends into (i.e., obstructs) the inner diameter of the visual back.
2. Slide the chrome portion of the star diagonal into the visual back.
3. Tighten the set screw on the visual back to hold the star diagonal in place.

If you wish to change the orientation of the star diagonal, loosen the set screw on the visual back until the star diagonal rotates freely. Rotate the diagonal to the desired position and tighten the set screw.

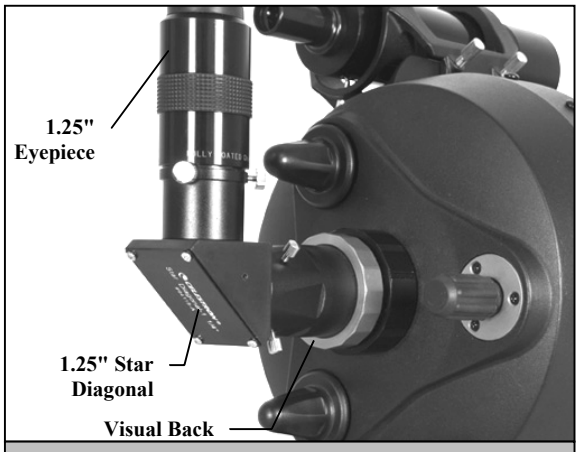


Figure 1-1 – Visual accessories for the 8"

To attach the 2" star diagonal onto the 9.25/11/14" optical tubes:

1. Remove the visual back from the rear of the tube.
2. Attach the threaded ring of the 2" diagonal to the rear cell of the telescope.
3. Loosen the thumb screws on the side of the diagonal and remove the 1.25" adapter from the barrel of the diagonal.

If you wish to change the orientation of the 2" star diagonal, loosen the retaining ring that attaches the diagonal to the rear cell. Rotate the diagonal to the desired position and tighten the retaining ring.

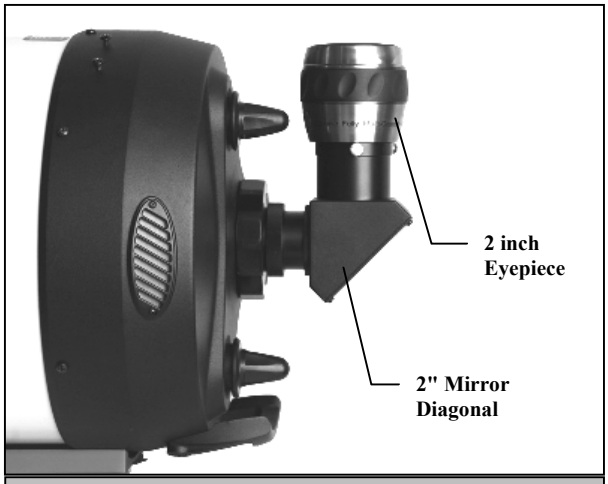


Figure 1-2 – Visual accessories for the 9.25/11/14"

Installing the Eyepiece

The eyepiece, or ocular, is an optical element that magnifies the image focused by the telescope. The eyepiece fits into either the visual back directly (8" only) or the star diagonal. To install an eyepiece:

1. Loosen the set screw on the star diagonal until the tip no longer extends into the inner diameter of the eyepiece end of the diagonal.

2. Slide the chrome portion of the eyepiece into the star diagonal.

3. Tighten the set screw on the star diagonal to hold the eyepiece in place.

To remove the eyepiece, loosen the set screw on the star diagonal and slide the eyepiece out.

Eyepieces are commonly referred to by focal length and barrel diameter. The focal length of each eyepiece is printed on the eyepiece barrel. The longer the focal length (i.e., the larger the number) the lower the eyepiece power and the shorter the focal length (i.e., the smaller the number) the higher the magnification. Generally, you will use low-to-moderate power when viewing. For more information on how to determine power, see the section on "Calculating Magnification."

Installing the Finderscope

The EdgeHD telescopes comes with a 9x50 finderscope. The specifications for a finderscope stand for the magnification and the aperture, in millimeters, of the scope. So, a 9x50 finder magnifies objects nine times and has a 50mm objective lens.

Finderscope Installation

The finderscope must first be mounted in the included quick-release bracket then attached to the rear cell of the telescope.

To install the finderscope:

1. Locate the finderscope mounting bracket attached to the bottom portion of the finder bracket. Loosen the two thumb screws to slide the mounting bracket from the finderscope bracket.
2. Find the two holes in the rear cell of the telescope on the top left, when looking from the back of the tube.
3. Place the mounting bracket over the two holes of the rear cell as shown in the figure 1-5.
4. Insert the screws through the bracket and into the rear cell.

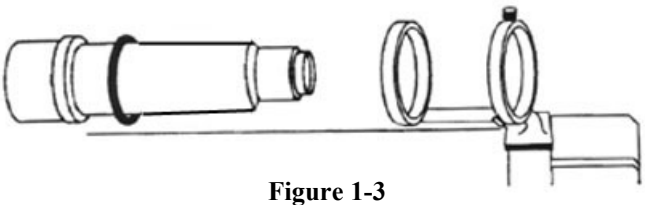


Figure 1-3

WARNING: If you remove the mounting bracket, do not completely thread the screws back into the rear cell of the telescope. The screws may be long enough to obstruct the movement of, and possibly damage the primary mirror.

With the bracket firmly attached to the telescope, you are ready to attach the finder to the bracket.

1. Slide the O-Ring over the back of the finderscope and position it on the tube toward the objective end of the finderscope.

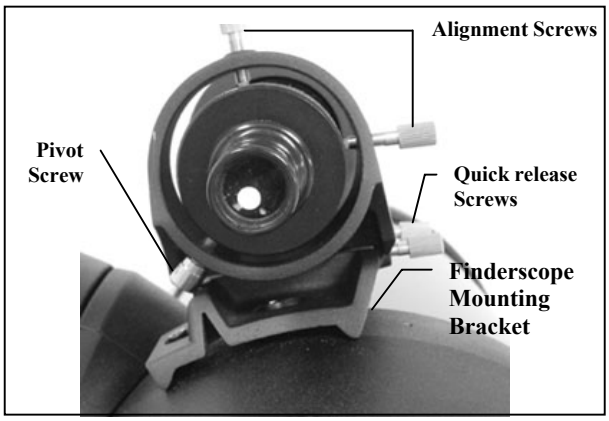


Figure 1-4

2. Slide the eyepiece end of the finderscope into the front ring of the bracket (the front ring is the one without the adjustment screws), then through the back ring. It may be necessary to push down the spring loaded pivot screw so that the finder will pass through the back ring (see figure 1-3)

3. Push the finder back until the O-Ring is snug inside the front ring of the finder bracket.

4. Hand tighten the two alignment thumb screws until they make contact with the finderscope.

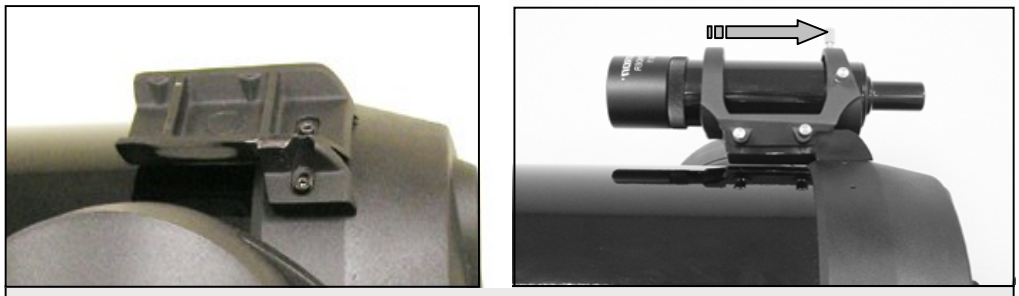


Figure 1-5
The finderscope bracket comes in two pieces; the mounting bracket (left) and the finder bracket (right)

Aligning the Finderscope

The finderscope is adjusted using two adjustment screws, located on the top and on the right (when looking though the finder) of the finder bracket and a spring loaded pivot screw (located on the left side of the bracket). This allows you to turn the top adjustment screw to move the finderscope up and down, and turn the right adjustment screw to move the finderscope right to left. The spring loaded pivot screw puts constant pressure on the finder so that the adjustment screws are always making contact with the finder.

To make the alignment process a little easier, you should perform this task in the daytime when it is easier to locate objects in the telescope without the finder. To align the finder:

1. Choose a conspicuous object that is in excess of one mile away. This will eliminate any possible parallax effect between the telescope and the finder.

2. Point your telescope at the object you selected and center it in the main optics of the telescope.

3. Lock the azimuth and altitude clamps to hold the telescope in place.

4. Check the finder to see where the object is located in the field of view.

5. Adjust the thumb screws on the finder bracket, until the cross hairs are centered on the target.

Removing the Lens Cap

The 8, 9.25 and11" lens cap utilizes a bayonet-type locking mechanism to hold it in place. To remove the lens cap, hold the cover firmly and rotate the outer edge 1/2” counterclockwise and pull off.

Telescope Basics

A telescope is an instrument that collects and focuses light. The nature of the optical design determines how the light is focused. Some telescopes, known as refractors, use lenses. Other telescopes, known as reflectors, use mirrors. The EdgeHD optical system (Apanatic Schmidt) uses a combination of mirrors and lenses and is referred to as a compound or catadioptric telescope. This unique design offers large-diameter optics while maintaining very short tube lengths, making them extremely portable. The EdgeHD system consists of a zero power corrector plate, a spherical primary mirror, and a secondary mirror along with a set of field flattening lens integrated into the baffle tube . Once light rays enter the optical system, they travel the length of the optical tube three times.

The optics of an EdgeHD telescopes have Starbright XLT coatings - enhanced multi-layer coatings on the primary and secondary mirrors for increased reflectivity and a fully coated corrector for the finest anti-reflection characteristics.

Inside the optical tube, a black tube extends out from the center hole in the primary mirror. This is the primary baffle tube and it prevents stray light from passing through to the eyepiece or camera.

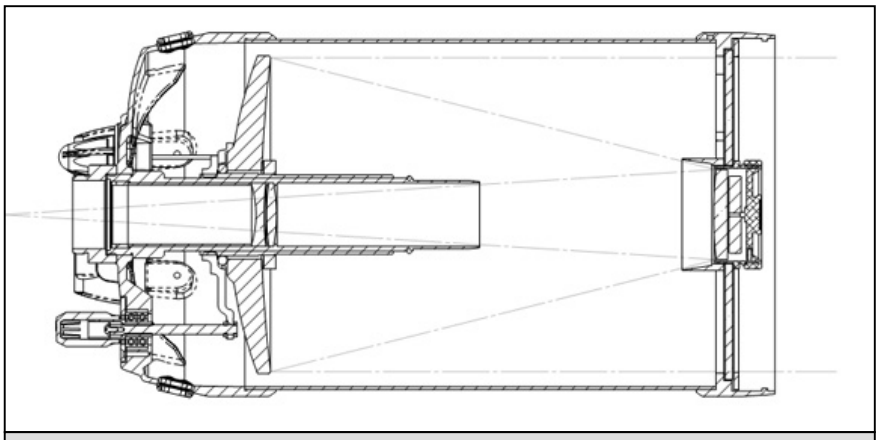


Figure 2-1
A cutaway view of the light path of the EdgeHD optical design

Image Orientation

The image orientation changes depending on how the eyepiece is inserted into the telescope. When using the star diagonal, the image is right-side-up, but reversed from left-to-right (i.e., mirror image). If inserting the eyepiece directly into the visual back (i.e., without the star diagonal), the image is upside-down and reversed from left-to-right (i.e., inverted). This is normal for the EdgeHD design.



Actual image orientation as seen with the unaided eye



Reversed from left to right, as viewed with a Star Diagonal



Inverted image, as viewed with the eyepiece directly in telescope

Figure 2-2

Focusing

Your telescope's focusing mechanism controls the primary mirror which is mounted on a ring that slides back and forth on the primary baffle tube. The focusing knob, which moves the primary mirror, is on the rear cell of the telescope just below the star diagonal and eyepiece. Turn the focusing knob until the image is sharp. If the knob will not turn, it has reached the end of its travel on the focusing mechanism. Turn the knob in the opposite direction until the image is sharp. Once an image is in focus, turn the knob clockwise to focus on a closer object and counterclockwise for a more distant object. A single turn of the focusing knob moves the primary mirror only slightly. Therefore, it will take many turns (about 30) to go from close focus to infinity.

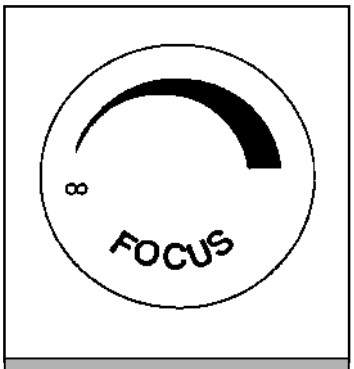


Figure 2-3 -The emblem on the end of the focus knob shows the correct rotational direction for focusing your telescope.

For astronomical viewing, out of focus star images are very diffuse, making them difficult to see. If you turn the focus knob too quickly, you can go right through focus without seeing the image. To avoid this problem, your first astronomical target should be a bright object (like the Moon or a planet) so that the image is visible even when out of focus. Critical focusing is best accomplished when the focusing knob is turned in such a manner that the mirror moves against the pull of gravity. In doing so, any mirror shift is minimized. For astronomical observing, both visually and photographically, this is done by turning the focus knob counterclockwise.

Mirror Support Clutches

The EdgeHD Optical tube is equipped with mirror tension clutches to help support and minimize lateral movement of the primary mirror during astrophotography.

To use the mirror clutches:

1. Use the focus knob to adjust the primary mirror to the desired focus.
2. Once in focus, turn the two mirror lock knobs clockwise until both are very tight and can be turned no further.

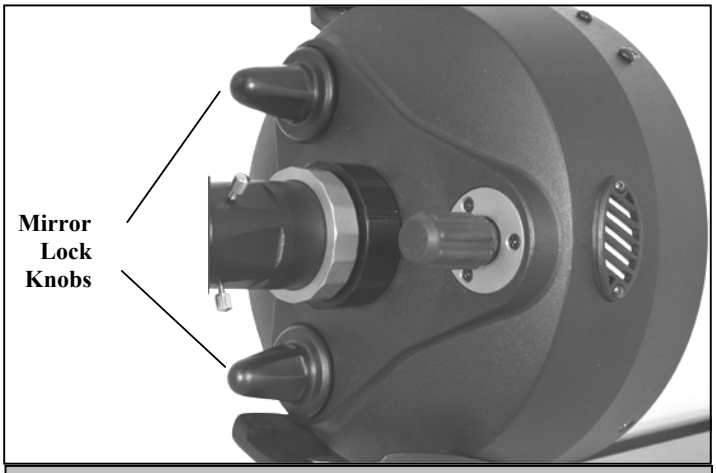


Figure 2-4 – Mirror Support Clutches

Warning! Once the mirror is locked down, do not turn the focuser knob without loosening the mirror locks first. Although turning the focus knob should not damage the telescope, undue stress can be placed on the focus mechanisms causing excessive image shift while focusing.

Calculating Magnification

You can change the power of your telescope just by changing the eyepiece (ocular). To determine the magnification of your telescope, simply divide the focal length of the telescope by the focal length of the eyepiece used. In equation format, the formula looks like this:

$$\text{Magnification} = \frac{\text{Focal Length of Telescope (mm)}}{\text{Focal Length of Eyepiece (mm)}}$$

Let's say, for example, you are using the 40mm Plossl eyepiece. To determine the magnification you simply divide the focal length of your telescope (the C8 for example has a focal length of 2032mm) by the focal length of the eyepiece, 40mm. Dividing 2032 by 40 yields a magnification of 51 power.

Although the power is variable, each instrument under average skies has a limit to the highest useful magnification. The general rule is that 60 power can be used for every inch of aperture. For example, the C8 is 8 inches in diameter. Multiplying 8 by 60 gives a maximum useful magnification of 480 power. Although this is the maximum useful magnification, most observing is done in the range of 20 to 35 power for every inch of aperture which is 160 to 280 times for the C8 telescope.

Determining Field of View

Determining the field of view is important if you want to get an idea of the angular size of the object you are observing. To calculate the actual field of view, divide the apparent field of the eyepiece (supplied by the eyepiece manufacturer) by the magnification. In equation format, the formula looks like this:

$$\text{True Field} = \frac{\text{Apparent Field of Eyepiece}}{\text{Magnification}}$$

As you can see, before determining the field of view, you must calculate the magnification. Using the example in the previous section, we can determine the field of view using the same 40mm eyepiece. The 40mm Plossl eyepiece has an apparent field of view of 46°. Divide the 46° by the magnification, which is 51 power. This yields an actual field of .9°, or nearly a full degree.

To convert degrees to feet at 1,000 yards, which is more useful for terrestrial observing, simply multiply by 52.5. Continuing with our example, multiply the angular field .9° by 52.5. This produces a linear field width of 47 feet at a distance of one thousand yards. The apparent field of each eyepiece that Celestron manufactures is found in the Celestron Accessory Catalog (#93685).

General Observing Hints

When working with any optical instrument, there are a few things to remember to ensure you get the best possible image.

- Never look through window glass. Glass found in household windows is optically imperfect, and as a result, may vary in thickness from one part of a window to the next. This inconsistency can and will affect the ability to focus your telescope. In most cases you will not be able to achieve a truly sharp image, while in some cases, you may actually see a double image.

- Never look across or over objects that are producing heat waves. This includes asphalt parking lots on hot summer days or building rooftops.

- Hazy skies, fog, and mist can also make it difficult to focus when viewing terrestrially. The amount of detail seen under these conditions is greatly reduced. Also, when photographing under these conditions, the processed film may come out a little grainier than normal with lower contrast and underexposed.

- If you wear corrective lenses (specifically glasses), you may want to remove them when observing with an eyepiece attached to the telescope. When using a camera, however, you should always wear corrective lenses to ensure the sharpest possible focus. If you have astigmatism, corrective lenses must be worn at all times.

CELESTRON Astrophotography

After looking at the night sky for a while you may want to try photographing it. Several forms of celestial photography are possible with your telescope, including short exposure prime focus, eyepiece projection, long exposure deep sky, terrestrial and even CCD imaging. Each of these is discussed in moderate detail with enough information to get you started. Topics include the accessories required and some simple techniques. More information is available in some of the publications listed at the end of this manual.

In addition to the specific accessories required for each type of celestial photography, there is the need for a camera - but not just any camera. The camera does not have to have many of the features offered on today's state-of-the-art equipment. For example, you don't need auto focus capability or mirror lock up. Here are the mandatory features a camera needs for celestial photography. First, a "B" setting which allows for time exposures. This excludes point and shoot cameras and limits the selection to SLR cameras, the most common type of 35mm camera on the market today.

Second, the "B" or manual setting should NOT run off the battery. Many new electronic cameras use the battery to keep the shutter open during time exposures. Once the batteries are drained, usually after a few minutes, the shutter closes, whether you were finished with the exposure or not. Look for a camera that has a manual shutter when operating in the time exposure mode. Olympus, Nikon, Minolta, Pentax, Canon and others have made such camera bodies.

The camera must have interchangeable lenses so you can attach it to the telescope and so you can use a variety of lenses for piggyback photography. If you can't find a new camera, you can purchase a used camera body that is not 100-percent functional. The light meter, for example, does not have to be operational since you will be determining the exposure length manually.

You also need a cable release with a locking function to hold the shutter open while you do other things. Mechanical and air release models are available.

Short Exposure Prime Focus Photography

Short exposure prime focus photography is the best way to begin recording celestial objects. It is done with the camera attached to the telescope without an eyepiece or camera lens in place. To attach your camera you need the Celestron T-Adapter (See Optional Accessories section) and a T-Ring for your specific camera (i.e., Canon, Nikon, etc.). The T-Ring replaces the 35mm SLR camera's normal lens. Prime focus photography allows you to capture the majority of the lunar disk or solar disk. To attach your camera to your telescope.

1. Remove all visual accessories. (For the 11" and 14" tube you must also remove the 3" adapter plate threaded onto the rear of the tube)
2. Thread the T-Ring onto the T-Adapter.
3. Mount your camera body onto the T-Ring the same as you would for a standard camera lens.
4. Thread the T-Adapter onto the back of the telescope while holding the camera in the desired orientation (either vertical or horizontal).

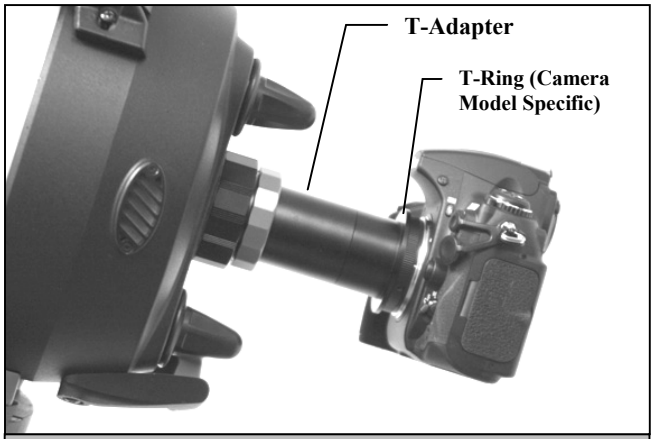


Figure 3-1 – T-Adapter for 8" Optical Tube

With your camera attached to the telescope, you are ready for prime focus photography. Start with an easy object like the Moon. Here's how to do it:

1. Center the Moon in the field of your telescope.

2. Focus the telescope by turning the focus knob until the image is sharp. Make sure the mirror lock knobs are loosened.

3. Set the shutter speed to the appropriate setting (see table below).

4. Trip the shutter using a cable release or self timer.

5. Use your camera's bracketing feature to automatically change exposure time in order to find the best exposure.

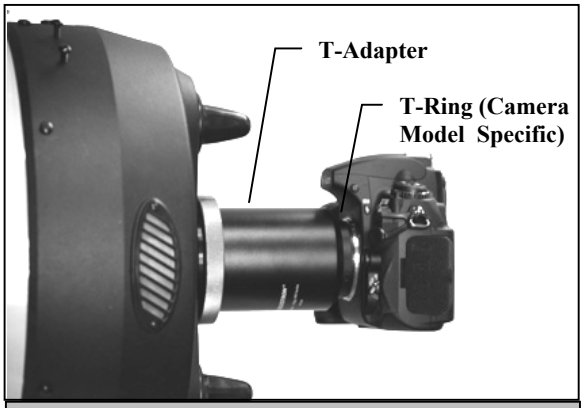


Figure 3-2 – T-Adapter for 11/14" Optical Tube

Lunar Phase	ISO 50	ISO 100	ISO 200	ISO 400
Crescent	1/2	1/4	1/8	1/15
Quarter	1/15	1/30	1/60	1/125
Full	1/30	1/60	1/125	1/250

Table 3-1
Above is a listing of recommended exposure times when photographing the Moon at the prime focus of your telescope.

The exposure times listed in table 7-1 should be used as a starting point. Always make exposures that are longer and shorter than the recommended time. Also, take a few photos at each shutter speed. This will ensure that you will get a good photo.

- This technique is also used for photographing the Sun with the proper solar filter.

Eyepiece Projection

This form of celestial photography is designed for objects with small angular sizes, primarily the Moon and planets. Planets, although physically quite large, appear small in angular size because of their great distances. Moderate to high magnification is, therefore, required to make the image large enough to see any detail. Unfortunately, the camera/telescope combination alone does not provide enough magnification to produce a usable image size on film. In order to get the image large enough, you must attach your camera to the telescope with the eyepiece in place. To do so, you need two additional accessories; a deluxe tele-extender (#93643), which attaches to the visual back, and a T-ring for your particular camera make (i.e., Minolta, Nikon, Pentax, etc.).

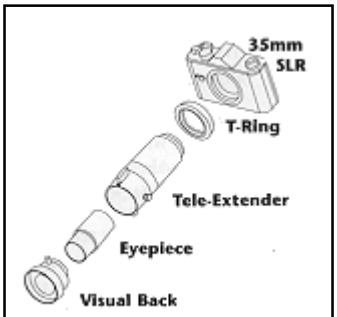


Figure 3-3 - Accessories for Projection Photography

Because of the high magnifications during eyepiece projection, the field of view is quite small which makes it difficult to find and center objects. To make the job a little easier, align the finder as accurately as possible. This allows you to get the object in the telescope's field based on the finder's view alone.

Another problem introduced by the high magnification is vibration. Simply tripping the shutter — even with a cable release — produces enough vibration to smear the image. To get around this, use the camera's self-timer if the exposure time is less than one second — a common occurrence when photographing the Moon. For exposures over one second, use the "hat trick." This technique incorporates a hand-held black card placed over the aperture of the telescope to act as a shutter. The card prevents light from entering the telescope while the shutter is released. Once the shutter has been released and the vibration has diminished (a few seconds), move the black card out of the way to expose the film. After the exposure is complete, place the card over the front of the telescope and close the shutter. Advance the film and you're ready for your next shot. Keep in mind that the card should be held a few inches in front of the telescope, and not touching it. It is easier if you use two people

for this process; one to release the camera shutter and one to hold the card. Here's the process for making the exposure.

1. Find and center the desired target in the viewfinder of your camera.

2. Turn the focus knob until the image is as sharp as possible.

3. Place the black card over the front of the telescope.

4. Release the shutter using a cable release.

5. Wait for the vibration caused by releasing the shutter to diminish. Also, wait for a moment of good seeing.

6. Remove the black card from in front of the telescope for the duration of the exposure (see accompanying table).

7. Replace the black card over the front of the telescope.

8. Close the camera's shutter.

Advance the film and you are ready for your next exposure. Don't forget to take photos of varying duration and keep accurate records of what you have done. Record the date, telescope, exposure duration, eyepiece, f/ratio, film, and some comments on the seeing conditions.

The following table lists exposures for eyepiece projection with a 10mm eyepiece. All exposure times are listed in seconds or fractions of a second.

Planet	ISO 50	ISO 100	ISO 200	ISO 400
Moon	4	2	1	1/2
Mercury	16	8	4	2
Venus	1/2	1/4	1/8	1/15
Mars	16	8	4	2
Jupiter	8	4	2	1
Saturn	16	8	4	2

Table 3-2
Recommended exposure time for photographing planets.

The exposure times listed here should be used as a starting point. Always make exposures that are longer and shorter than the recommended time. Also, take a few photos at each shutter speed. This will ensure that you get a good photo. It is not uncommon to go through an entire roll of 36 exposures and have only one good shot.

NOTE: Don't expect to record more detail than you can see visually in the eyepiece at the time you are photographing.

Once you have mastered the technique, experiment with different films, different focal length eyepieces, and even different filters.

Long Exposure Prime Focus Photography

This is the last form of celestial photography to be attempted after others have been mastered. It is intended primarily for deep sky objects, that is objects outside our solar system which includes star clusters, nebulae, and galaxies. While it may seem that high magnification is required for these objects, just the opposite is true. Most of these objects cover large angular areas and fit nicely into the prime focus field of your telescope. The brightness of these objects, however, requires long exposure times and, as a result, are rather difficult.

There are several techniques for this type of photography, and the one chosen will determine the standard accessories needed. The best method for long exposure deep sky astrophotography is with an off-axis guider.

This device allows you to photograph and guide through the telescope simultaneously. Celestron offers a very special and advanced off-axis guider, called the Radial Guider (#94176). In addition, you will need a T-Ring to attach your camera to the Radial Guider.

Other equipment needs include a guiding eyepiece. Unlike other forms of astrophotography which allows for fairly loose guiding, prime focus requires meticulous guiding for long periods. To accomplish this you need a guiding ocular with an illuminated reticle to monitor your guide star. For this purpose, Celestron offers the Micro Guide Eyepiece (#94171) Here is a brief summary of the technique.

1. Polar align the telescope. For more information on polar aligning, see the Polar Alignment section earlier in the manual.

2. Remove all visual accessories.

3. Thread the Radial Guider onto your telescope.

4. Thread the T-Ring onto the Radial Guider.

5. Mount your camera body onto the T-Ring the same as you would any other lens.

6. Set the shutter speed to the "B" setting.

7. Focus the telescope on a star.

8. Center your subject in the field of your camera.

9. Find a suitable guide star in the telescope field. This can be the most time consuming process.

10. Open the shutter using a cable release.

11. Monitor your guide star for the duration of the exposure using the buttons on the hand controller to make the needed corrections.

12. Close the camera's shutter.

When getting started, use a fast ISO setting to record as much detail in the shortest possible time.

Metering

The EdgeHD telescopes have a fixed aperture and, as a result, fixed f/ratios. To properly expose your subjects photographically, you need to set your shutter speed accordingly. Most 35mm SLR cameras offer through-the-lens metering which lets you know if your picture is under or overexposed. Adjustments for proper exposures are made by changing the shutter speed. Consult your camera manual for specific information on metering and changing shutter speeds.

Reducing Vibration

Releasing the shutter manually can cause vibrations, producing blurred photos. To reduce vibration when tripping the shutter, use a cable release. A cable release keeps your hands clear of the camera and lens, thus eliminating the possibility of introducing vibration. Mechanical shutter releases can be used, though air-type releases are best.
Blurry pictures can also result from shutter speeds that are too slow. To prevent this, use films that produce shutter speeds greater than 1/250 of a second when hand-holding the lens. If the lens is mounted on a tripod, the exposure length is virtually unlimited.

Another way to reduce vibration is with the Vibration Suppression Pads (#93503). These pads rest between the ground and tripod feet. They reduce the vibration amplitude and vibration time.

CCD Imaging

Fastar Option – Using your EdgeHD telescope at f/2 with optional lens assembly

The EdgeHD telescopes are equipped with a removable secondary mirror that allows you to convert your f/10 telescope into an f/2 imaging system capable of exposure times 25 times shorter than those needed with a f/10 system! The Fastar compatible telescope's versatility allows it to be used in many different f-number configurations for CCD imaging, making it the most versatile imaging system available today. With an optional lens assembly you can easily convert your Fastar compatible telescope to f/2 prime focus use in a matter of seconds. This makes the system ideal for imaging deep-sky objects as well as planetary detail. Described below is the configuration of each F-number and the type of object best suited to that kind of imaging.

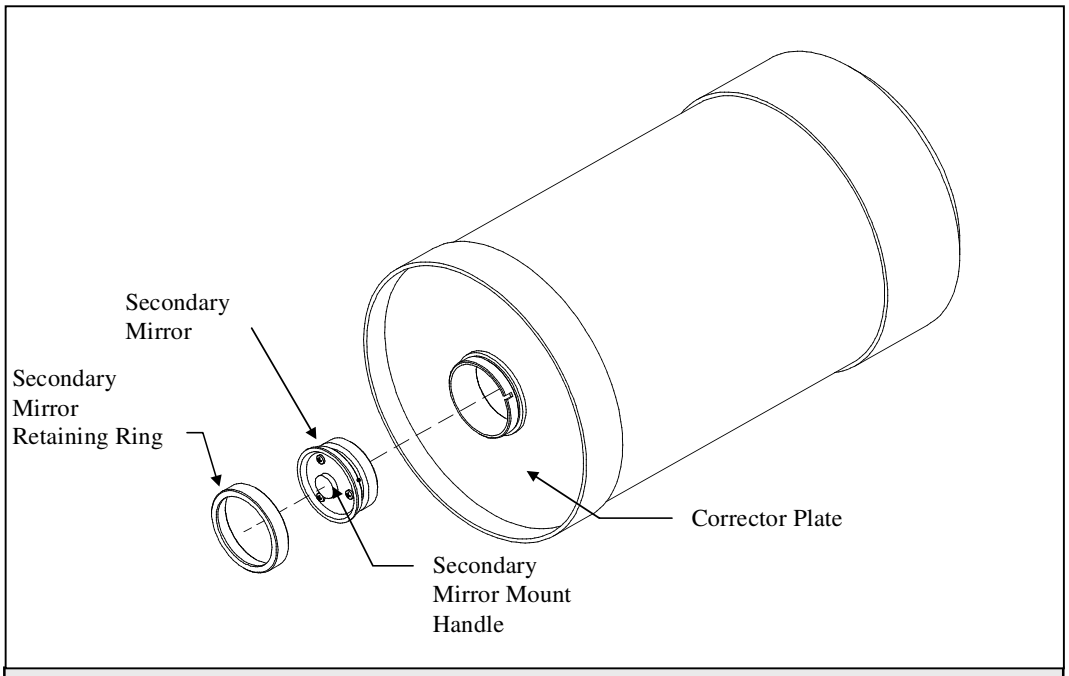


Figure 3-4 - The Fastar Compatible Optical System

The above figure shows how the secondary mirror is removed when using the optional CCD camera for f/2imaging.

Warning: The secondary mirror should never be removed unless installing the optional f/2 lens assembly. Adjustments to collimation can easily be made by turning the screws on the top of the secondary mirror mount without ever having to remove the secondary mirror (see Telescope Maintenance section of this manual).

The F/# stands for the ratio between the focal length and the diameter of the light gathering element. For example, the EdgeHD 11" optical tube has a focal length of 110 inches and a diameter of 11 inches. This makes the system an f/10, (focal length divided by diameter). When the secondary is removed and the CCD camera is placed at the Fastar position, the system becomes f/2, this is a unique feature to some Celestron telescopes (see figures below).

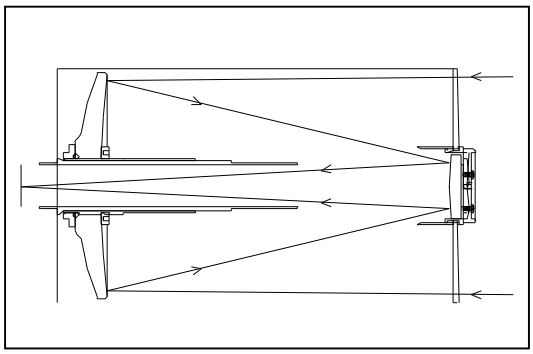


Figure 3-5

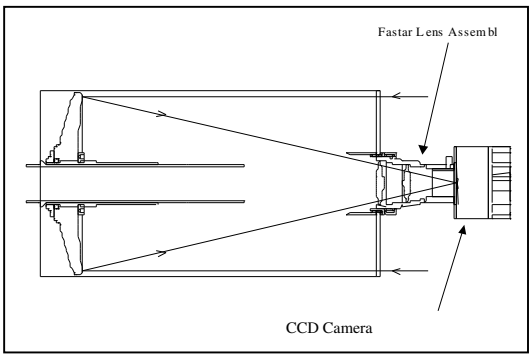


Figure 3-6

The key factors for good CCD imaging are; exposure time, field-of-view, image size, and pixel resolution. As the F-number goes down (or gets faster), the exposure times needed decreases, the field-of-view-increases, but the image scale of the object gets smaller. What is the difference between f/2 and f/10? F/2 has 1/5 the focal length of f/10. That makes the exposure time needed about 25 times shorter than at f/10, the field of view 5 times larger and the object size 1/5 compared to that of f/10. (see Table below)

	Telescope Model	**Standard f/10 Configuration**	**f/2 Configuration**
Focal Length & Speed	8"	80" (2032mm)	16" (406.4mm)
	9.25"	93" (2350mm)	18.5" (470mm)
	11"	110" (2800mm)	23.1" (587mm)
	14"	154" (3910mm)	28" (711mm)

Table 3-3

CELESTRON Telescope Maintenance

While your telescope requires little maintenance, there are a few things to remember that will ensure your telescope performs at its best.

Care and Cleaning of the Optics

Occasionally, dust and/or moisture may build up on the corrector plate of your telescope. Special care should be taken when cleaning any instrument so as not to damage the optics.

If dust has built up on the corrector plate, remove it with a brush (made of camel's hair) or a can of pressurized air. Spray at an angle to the lens for approximately two to four seconds. Then, use an optical cleaning solution and white tissue paper to remove any remaining debris. Apply the solution to the tissue and then apply the tissue paper to the lens. Low pressure strokes should go from the center of the corrector to the outer portion. **Do NOT rub in circles!**

You can use a commercially made lens cleaner or mix your own. A good cleaning solution is isopropyl alcohol mixed with distilled water. The solution should be 60% isopropyl alcohol and 40% distilled water. Or, liquid dish soap diluted with water (a couple of drops per one quart of water) can be used.

Occasionally, you may experience dew build-up on the corrector plate of your telescope during an observing session. If you want to continue observing, the dew must be removed, either with a hair dryer (on low setting) or by pointing the telescope at the ground until the dew has evaporated.

If moisture condenses on the inside of the corrector, remove the accessories from the rear cell of the telescope. Place the telescope in a dust-free environment and point it down. This will remove the moisture from the telescope tube.

To minimize the need to clean your telescope, replace all lens covers once you have finished using it. Since the rear cell is NOT sealed, the cover should be placed over the opening when not in use. This will prevent contaminants from entering the optical tube.

Internal adjustments and cleaning should be done only by the Celestron repair department. If your telescope is in need of internal cleaning, please call the factory for a return authorization number and price quote.



Figure 4-1
Rotate the collimation screw cover to access the three collimation screw.

Collimation

The optical performance of your telescope is directly related to its collimation, that is the alignment of its optical system. Your telescope was collimated at the factory after it was completely assembled. However, if the telescope is dropped or jarred severely during transport, it may have to be collimated. The only optical element that may need to be adjusted, or is possible, is the tilt of the secondary mirror.

To check the collimation of your telescope you will need a light source. A bright star near the zenith is ideal since there is a minimal amount of atmospheric distortion. Make sure that tracking is on so that you won't have to manually track the star. Or, if you do not want to power up your telescope, you can use Polaris. Its position relative to the celestial pole means that it moves very little thus eliminating the need to manually track it.

Before you begin the collimation process, be sure that your telescope is in thermal equilibrium with the surroundings. Allow 45 minutes for the telescope to reach equilibrium if you move it between large temperature extremes.

To verify collimation, view a star near the zenith. Use a medium to high power ocular — 12mm to 6mm focal length. It is important to center a star in the center of the field to judge collimation. Slowly cross in and out of focus and judge the symmetry of the star. If you see a systematic skewing of the star to one side, then re-collimation is needed.

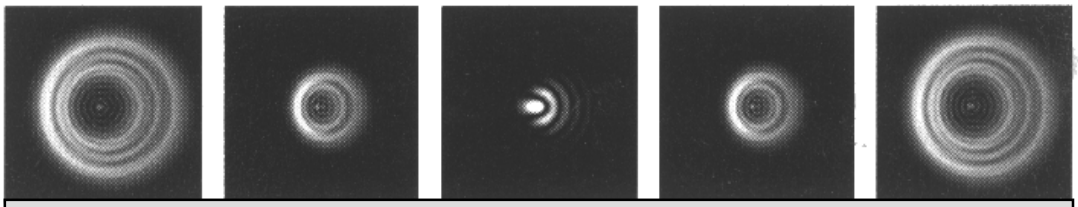


Figure 4-2 -- Even though the star pattern appears the same on both sides of focus, they are asymmetric. The dark obstruction is skewed off to the left side of the diffraction pattern indicating poor collimation.

To accomplish this, you need to tighten the secondary collimation screw(s) that move the star across the field toward the direction of the skewed light. These screws are located in the secondary mirror holder (see figure 4-1). Make only small 1/6 to 1/8 adjustments to the collimation screws and re-center the star by moving the scope before making any improvements or before making further adjustments.

To make collimation a simple procedure, follow these easy steps:

1. While looking through a medium to high power eyepiece, de-focus a bright star until a ring pattern with a dark shadow appears (see figure 4-2). Center the de-focused star and notice in which direction the central shadow is skewed.

2. Place your finger along the edge of the front cell of the telescope (be careful not to touch the corrector plate), pointing towards the collimation screws. The shadow of your finger should be visible when looking into the eyepiece. Rotate your finger around the tube edge until its shadow is seen closest to the narrowest portion of the rings (i.e. the same direction in which the central shadow is skewed).

3. Locate the collimation screw closest to where your finger is positioned. This will be the collimation screw you will need to adjust first. (If your finger is positioned exactly between two of the collimation screws, then you will need to adjust the screw opposite where your finger is located).

4. Use the hand control buttons to move the de-focused star image to the edge of the field of view, in the same direction that the central obstruction of the star image is skewed.

5. While looking through the eyepiece, use an Allen wrench to turn the collimation screw you located in step 2 and 3. Usually a tenth of a turn is enough to notice a change in collimation. If the star image moves out of the field of view in the direction that the central shadow is skewed, than you are turning the collimation screw the wrong way. Turn the screw in the opposite direction, so that the star image is moving towards the center of the field of view.

6. If while turning you notice that the screws get very loose, then simply tighten the other two screws by the same amount. Conversely, if the collimation screw gets too tight, then loosen the other two screws by the same amount.

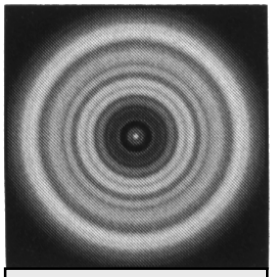


Figure 4-3
A collimated telescope should appear symmetrical with the central obstruction centered in the star's diffraction pattern.

7. Once the star image is in the center of the field of view, check to see if the rings are concentric. If the central obstruction is still skewed in the same direction, then continue turning the screw(s) in the same direction. If you find that the ring pattern is skewed in a different direction, than simply repeat steps 2 through 6 as described above for the new direction.

Perfect collimation will yield a star image very symmetrical just inside and outside of focus. In addition, perfect collimation delivers the optimal optical performance specifications that your telescope is built to achieve.

If seeing (i.e., air steadiness) is turbulent, collimation is difficult to judge. Wait until a better night if it is turbulent or aim to a steadier part of the sky. A steadier part of the sky is judged by steady versus twinkling stars.

Optional Accessories

You will find that additional accessories enhance your viewing pleasure and expand the usefulness of your telescope. For ease of reference, all the accessories are listed in alphabetical order.

Barlow Lens - A Barlow lens is a negative lens that increases the focal length of a telescope. Used with any eyepiece, it doubles the magnification of that eyepiece. Celestron offers two Barlow lens in the 1-1/4" size. The 2x Ultima Barlow (#93506) is a compact triplet design that is fully multicoated for maximum light transmission and parfocal when used with the Ultima eyepieces. The OMNI Barlow (#93326) is a compact achromatic Barlow lens that is under three inches long and weighs only 4 oz. It works very well with all Celestron eyepieces.

Erect Image Diagonal (#94112-A) - This accessory is an Amici prism arrangement that allows you to look into the telescope at a 45° angle with images that are oriented properly (upright and correct from left-to-right). It is useful for daytime, terrestrial viewing.

Eyepieces - Like telescopes, eyepieces come in a variety of designs. Each design has its own advantages and disadvantages. For the 1-1/4" barrel diameter there are four different eyepiece designs available.



- **OMNI Plössl** - Plössl eyepieces have a 4-element lens designed for low-to-high power observing. The Plössls offer razor sharp views across the entire field, even at the edges! In the 1-1/4" barrel diameter, they are available in the following focal lengths: 4mm, 6mm, 9mm, 12.5mm, 15mm, 20mm, 25mm, 32mm and 40mm.

- **X-Cel -** This 6 element design allows each X-Cel Eyepiece to have 20mm of eye relief, 55° field of view and more than 25mm of lens aperture (even with the 2.3mm). In order to maintain razor sharp, color corrected images across its 55° field of view, extra-low dispersion glass is used for the most highly curved optical elements. The excellent refractive properties of these high grade optical elements, make the X-Cel line especially well suited for high magnification planetary viewing where sharp, color-free views are most appreciated. X-Cel eyepiece come in the following focal lengths: 2.3mm, 5mm, 8mm, 10mm, 12.5mm, 18mm, 21mm, 25mm.



• **Ultima LX –**Celestron Ultima LX Series parfocal eyepieces feature wide fields of view for high and low magnifications. 70 º field of view for high and low magnifications and extendable twist-up eyecups - Good for eyeglass wearers. Available in the following focal lengths: 5mm, 8mm, 13mm, 17mm, 22mm, and 32mm.

• **Axiom –** Celestron Axiom LX Series parfocal eyepieces
feature scratch resistant, high end design and 80 º fields of view for high and low magnifications. .Retractable eyecups for ultra-low profile viewing, idea for eyeglass wearers. Available in the following focal lengths: 7mm, 10mm, 15mm, 19mm, 23mm, and 31mm.

Filters Sets, Eyepiece - Celestron offers four convenient filter sets, which contain four different filters per set. Not only are these highly useful filter combinations, but they also offer an economical way to add versatility to your filter collection.

Series 1 – #94119-10
Orange, Light Blue, ND13%T, Polarizing (#s 21, 80A, #15, Polarizing)

Series 2 – #94119-20
Deep Yellow, Red, Light Green, ND25% T (#s 12, 25, 56, 96ND-25)

Series 3 – #94119-30
Light Red, Blue, Green, ND50% T (#s 23A, 38A, 58, 96ND-50)

Series 4 – #94119-40
Yellow, Deep Yellow, Violet, Pale Blue (#s 8, 47, 82A, ND96-13)

Light Pollution Reduction (LPR) Filters - These filters are designed to enhance your views of deep sky astronomical objects when viewed from urban areas. LPR Filters selectively reduce the transmission of certain wavelengths of light, specifically those produced by artificial lights. This includes mercury and high and low pressure sodium vapor lights. In addition, they also block unwanted natural light (sky glow) caused by neutral oxygen emission in our atmosphere. Celestron offers a model for 1-1/4" eyepieces (#94123) and a 2" eyepieces.(#94124).



Micro Guide Eyepiece (#94171) - This multipurpose 12.5mm illuminated reticle can be used for guiding deep-sky astrophotos, measuring position angles, angular separations, and more. The laser etched reticle provides razor sharp lines and the variable brightness illuminator is completely cordless. The micro guide eyepiece produces 163 power with the C8 and 188 power with the C9.25.

Polarizing Filter Set (#93608) - The polarizing filter set limits the transmission of light to a specific plane, thus increasing contrast between various objects. This is used primarily for terrestrial, lunar and planetary observing.

Radial Guider (#94176) - The Celestron Radial Guider® is specifically designed for use in prime focus, deep sky astrophotography and takes the place of the T-Adapter. This device allows you to photograph and guide simultaneously through the optical tube assembly of your telescope. This type of guiding produces the best results since what you see through the guiding eyepiece is exactly reproduced on the processed film. The Radial Guider is a "T"-shaped assembly that attaches to the rear cell of the telescope. As light from the telescope enters the guider, most passes straight through to the camera. A small portion, however, is diverted by a prism at an adjustable angle up to the guiding eyepiece. This guider has two features not found on other off-axis guiders; first, the prism and eyepiece housing rotate independently of the camera orientation making the acquisition of a guide star quite easy. Second, the prism angle is tunable allowing you to look at guide stars on-axis. This accessory works especially well with the Reducer/Corrector.

Skylight Filter (#93621) - The Skylight Filter is used on the Celestron telescope as a dust seal. The filter threads onto the rear cell of your telescope. All other accessories, both visual and photographic (with the exception of Barlow lenses), thread onto the skylight filter. The light loss caused by this filter is minimal.

Solar Filter - The Baader AstroSolar® filter is a safe and durable filter that covers the front opening of the telescope. View sunspots and other solar features using this double-sided metal coated filter for uniform density and good color balance across the entire field. The Sun offers constant changes and will keep your observing interesting and fun. C8 - #94128, C11 - #94238.

T-Adapter - T-Adapter (with additional T-Ring) allows you to attach your SLR camera to the rear cell of your Celestron telescope. This turns your telescope into a high power telephoto lens perfect for terrestrial photography and short exposure lunar and filtered solar photography. #93644 for the 8" and #93646 for the 9/11/14" optical tubes.

T-Ring - The T-Ring couples your 35mm SLR camera body to the T-Adapter, radial guider, or tele-extender. This accessory is mandatory if you want to do photography through the telescope. Each camera make (i.e., Minolta, Nikon, Pentax, etc.) has its own unique mount and therefore, its own T-Ring. Celestron has 8 different models for 35mm cameras.

A full description of all Celestron accessories can be found in the Celestron Accessory Catalog (#93685)

CELESTRON TWO YEAR WARRANTY

A. Celestron warrants this telescope to be free from defects in materials and workmanship for two years. Celestron will repair or replace such product or part thereof which, upon inspection by Celestron, is found to be defective in materials or workmanship. As a condition to the obligation of Celestron to repair or replace such product, the product must be returned to Celestron together with proof-of-purchase satisfactory to Celestron.

B. The Proper Return Authorization Number must be obtained from Celestron in advance of return. Call Celestron at (310) 328-9560 to receive the number to be displayed on the outside of your shipping container.

All returns must be accompanied by a written statement setting forth the name, address, and daytime telephone number of the owner, together with a brief description of any claimed defects. Parts or product for which replacement is made shall become the property of Celestron.

The customer shall be responsible for all costs of transportation and insurance, both to and from the factory of Celestron, and shall be required to prepay such costs.

Celestron shall use reasonable efforts to repair or replace any telescope covered by this warranty within thirty days of receipt. In the event repair or replacement shall require more than thirty days, Celestron shall notify the customer accordingly. Celestron reserves the right to replace any product which has been discontinued from its product line with a new product of comparable value and function.

This warranty shall be void and of no force of effect in the event a covered product has been modified in design or function, or subjected to abuse, misuse, mishandling or unauthorized repair. Further, product malfunction or deterioration due to normal wear is not covered by this warranty.

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Some states do not allow the exclusion or limitation of incidental or consequential damages or limitation on how long an implied warranty lasts, so the above limitations and exclusions may not apply to you.

This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Celestron reserves the right to modify or discontinue, without prior notice to you, any model or style telescope.

If warranty problems arise, or if you need assistance in using your telescope contact:

Celestron
Customer Service Department
2835 Columbia Street
Torrance, CA 90503 U.S.A.
Tel. (310) 328-9560
Fax. (310) 212-5835
Monday-Friday 8AM-4PM PST

This warranty supersedes all other product warranties.

NOTE: This warranty is valid to U.S.A. and Canadian customers who have purchased this product from an Authorized Celestron Dealer in the U.S.A. or Canada. Warranty outside the U.S.A. and Canada is valid only to customers who purchased from a Celestron Distributor or Authorized Celestron Dealer in the specific country and please contact them for any warranty service.



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