

Orion® EON™ ED90T 90mm ED Triplet Carbon Fiber Apochromatic Refractor

#10386

Congratulations on your purchase of an Orion® EON ED90T CF 90mm ED Triplet Carbon Fiber Apochromatic Refractor! This premium telescope excels for both visual observing and astrophotography. It is designed with high quality precision ED optics and superior mechanical construction. The optical tube is made from lightweight, thermally stable carbon fiber material, which makes the telescope lighter and less prone to rapid expansion and contraction with changes in temperature. The sturdy 2.5" dual-speed (10:1) rack-and-pinion focuser will rigidly support substantial imaging or visual equipment loads and provide smooth, backlash-free focusing. The extra-low dispersion, or "ED," optics offer outstanding color correction. These instructions will help you set up and use your telescope.



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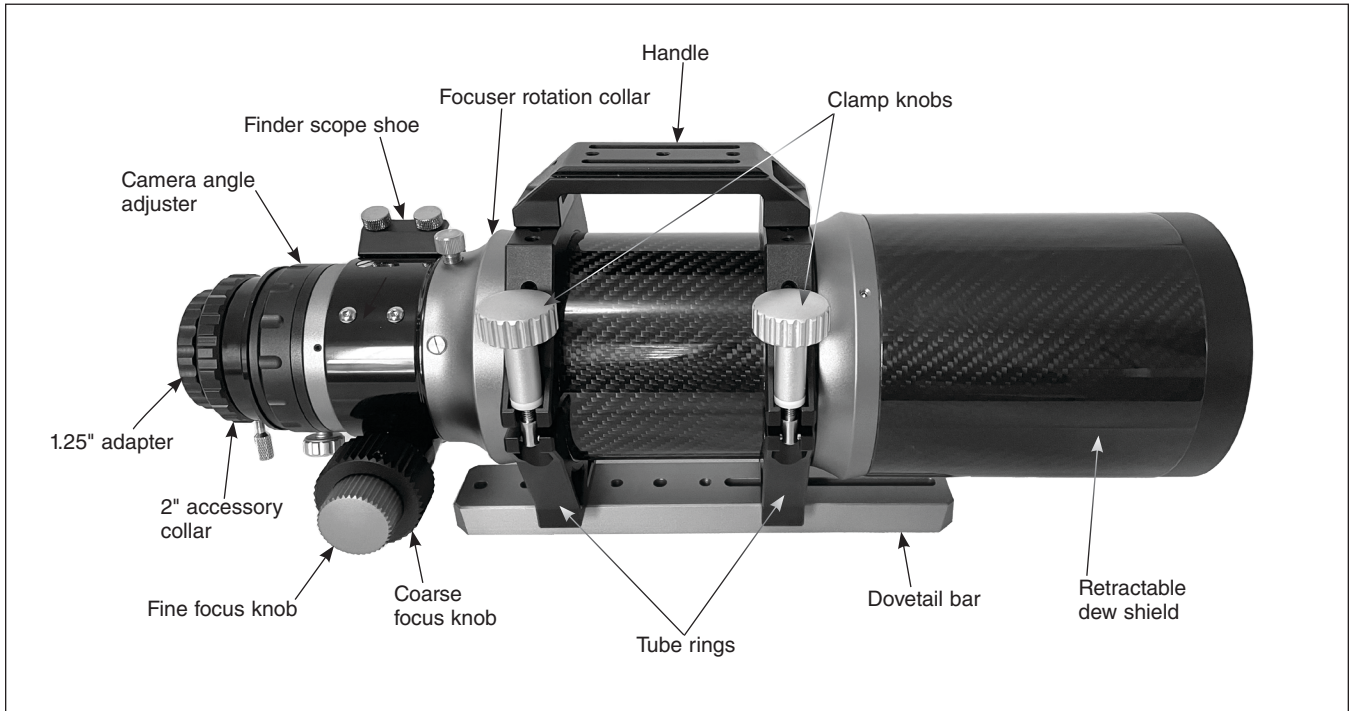


Figure 1. Features and components of the EON ED90T Carbon Fiber Apochromatic Refractor

WARNING: Do NOT look at the Sun without a professionally made solar filter on the telescope; serious eye damage may result if you look at the Sun with any unfiltered optical instrument. Do not leave the telescope unsupervised around children. Always cover the lenses when leaving the telescope in direct sunlight.

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1. Parts List

- EON ED90T CF optical tube assembly
- Aluminum objective cap
- Protective cap for fine focus knob
- 2"-to-1.25" twist-tight adapter
- Tube ring assembly with dovetail mounting bar and handle
- Thumbscrew for dew shield
- Hard carrying case

The EON ED90T CF apochromatic refractor comes fully assembled from the factory. The telescope's optics have been assembled and precisely collimated at the factory, so they should not require any adjustments. Please keep the original shipping box. In the unlikely event that you need to ship the telescope back to Orion for warranty repair service, you should use the original packaging.

2. Features and Functions

The EON ED90T CF apochromatic refractor has premium features designed to maximize the performance of the scope and its convenience of use. Please refer to **Figure 1** to become familiar with the telescope's features.

Optics

The EON ED90T CF incorporates an air-spaced triplet lens assembly, with one ED (extra-low dispersion) lens made from FCD100 ED glass by Hoya of Japan. It is essentially equivalent

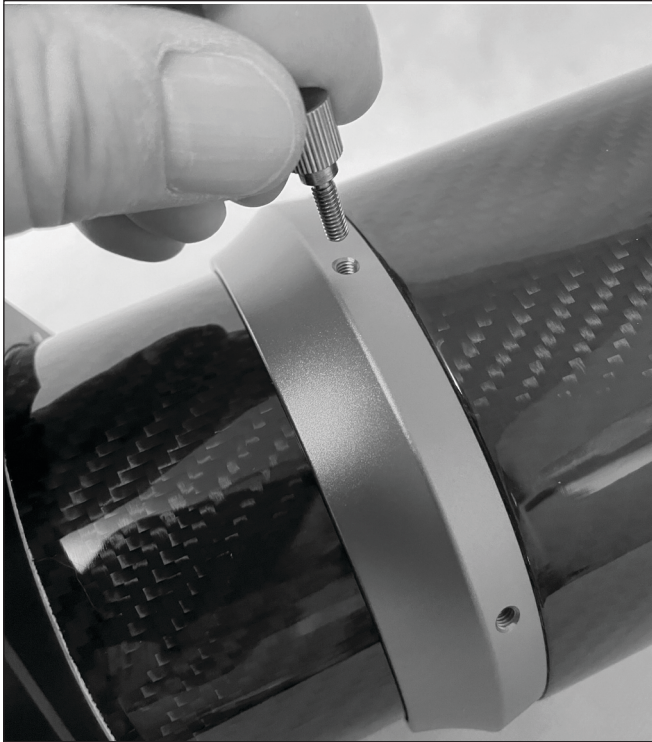


Figure 2. Thread the thumbscrew included separately into the hole in the collar behind the dew shield.

to FPL-53 glass manufactured by Ohara. FCD100 is an extremely low dispersion optical glass equivalent to fluorite (CaF₂). It provides advanced correction of chromatic aberration, which results in sharper images both visually and photographically.

The ED90T CF's lenses are fully multi-coated – meaning all air-to-glass surfaces have multi-layer antireflective coatings applied – for maximum light transmission to the eyepiece or camera. In addition, the lens edges are blackened before they are mounted in the lens cell to prevent unwanted reflections from affecting the image quality.

Retractable Dew Shield

The dew shield of the EON ED90T CF is retractable, allowing the telescope to become more compact for storage. With the dew shield extended, the scope is 19.8" long; with the dew shield retracted (and tube rings still attached), the length reduces to 18". The dew shield's primary purpose is to inhibit dew (water condensation) from forming on the lens during cold and humid nights. The dew shield is also useful for reducing glare from unwanted outside lights.

The dew shield comes fully retracted in the carrying case. To extend the dew shield, simply pull it forward until it stops. A thumbscrew included (in a small plastic bag) with the telescope should be threaded into the hole in the red collar just behind the dew shield (**Figure 2**). The thumbscrew should be lightly tightened once the dew shield is fully extended, then loosened when you want to retract the dew shield.

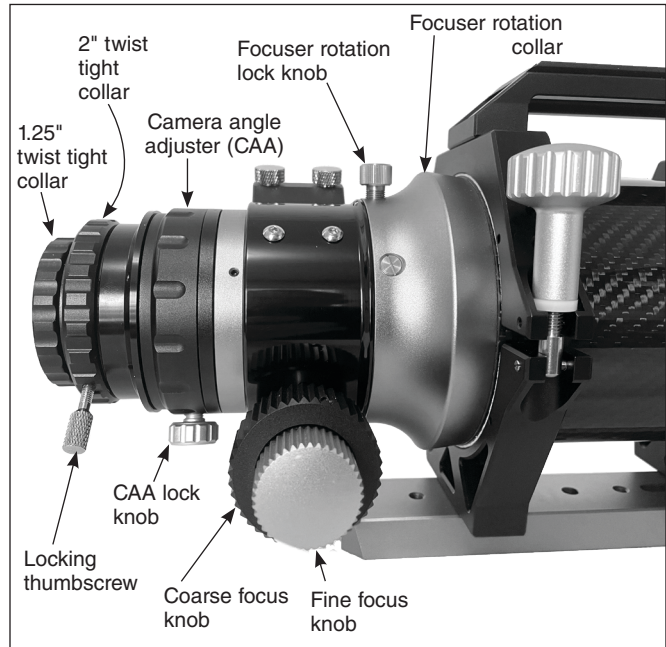


Figure 3. The 2.5" dual-speed focuser has a rotatable collar as well as a Camera Angle Adjuster.

Dual-Speed 2.5" Rack-and-Pinion Focuser

Focusing the EON ED90T CF is smooth and responsive, thanks to the all-machined, 2.5" rack-and-pinion focuser (**Figure 3**). It features a bias (diagonal) cut on the rack to provide exceptionally smooth, backlash-free focus motion and excellent rigidity for holding imaging trains. This rack-and-pinion design is superior to Crayford designs because it minimizes focuser slip with heavier loads and pointing high in the sky – critical when trying to obtain precise and repeatable focus. In our tests this focuser held up to 19 lbs. without slippage.

The dual-speed focusing mechanism will keep your target object crisp and sharp. For quick focusing, the two large focus knobs provide a coarse focus. For more precise focusing, as needed for applications such as high-power planetary observing and imaging with a CCD or digital camera, the smaller focus knob on the right side offers a 10:1 fine focus adjustment (10 turns of the fine focus knob equals one turn of the coarse focus knob).

If you find that the focusing motion is too stiff or if the drawtube slips under the weight of your eyepiece or camera, you can make adjustments to the focuser tension by using the focuser tension thumbscrew located on the bottom side of the focuser (**Figure 4**). Make adjustments to this setscrew until the focuser motion feels smooth and holds in place when you have obtained focus. It may be necessary to make adjustments when the weight of your accessories changes significantly.

Twist-Tight Accessory Collars

The EON ED90T CF features a 2" twist-tight collar and a 1.25" twist-tight adapter (**Figure 5**). The twist-tight mechanism replaces and is superior to conventional collars that utilize only a thumbscrew to secure accessories to the focuser. The twist-tight mechanism provides an extremely secure attachment with just a twist of the large knurled collar. Both collars have a non-marring

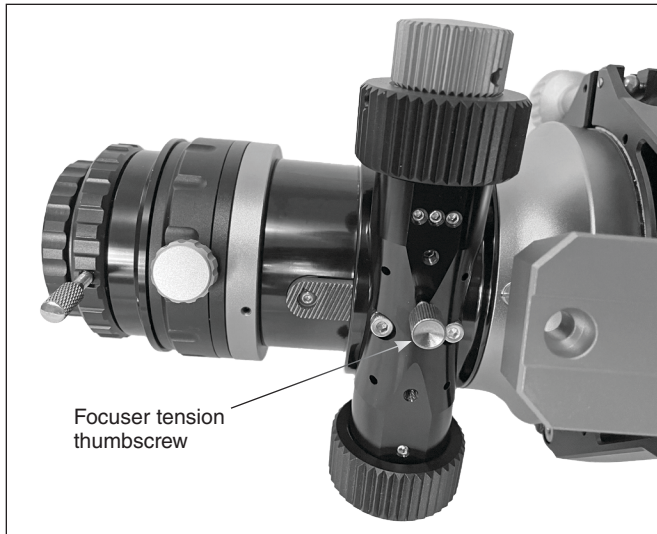


Figure 4. The underside of the focuser features a focuser tension thumbscrew.

internal compression ring for securing a diagonal, field flattener, camera adapter, or other accessories. To insert an accessory into the collar, first twist the collar counterclockwise to widen the internal compression ring, then insert your 2" accessory into the collar (or your 1.25" accessory into the 1.25" collar). Then just twist the collar clockwise until it is tight. The 2" collar also has a thumb screw to provide an added measure of security.

Engraved Millimeter Scale on Focuser Drawtube

The drawtube of the EON ED90T CF's focuser features a laser-engraved millimeter scale on top, which aids in providing repeatable focus. When precise focus is achieved, noting the value on the scale where the drawtube meets the focuser housing will allow you to return to approximately the same point, such as when focusing the same camera in subsequent imaging sessions. Using the scale can save time compared to finding the focusing point "from scratch" each time.

Focuser Rotation and Camera Angle Adjustment (CAA)

The focuser on the EON ED90T CF has two rotatable components. First, the entire focuser can be rotated just behind the tapered red collar where the focuser attaches to the optical tube (see **Figure 1**). On that collar is a thumbscrew, which when tightened locks the focuser in position and when loosened allows the focuser to be rotated. Rotating the focuser will re-orient the focus knobs to a position that may be more desirable, depending on your mount setup and what you're observing or imaging. For instance, this feature can allow you to keep the focus knobs parallel to the ground no matter how your telescope is positioned.

Second, the Camera Angle Adjustment (CAA) is the grooved collar just in front of the 2" accessory holder (**Figure 1**). It has a knob that when loosened allows the collar to be rotated. The CAA is useful for astrophotography by allowing the camera to be rotated independent of the rest of the telescope in order to frame a target object on the camera's sensor.

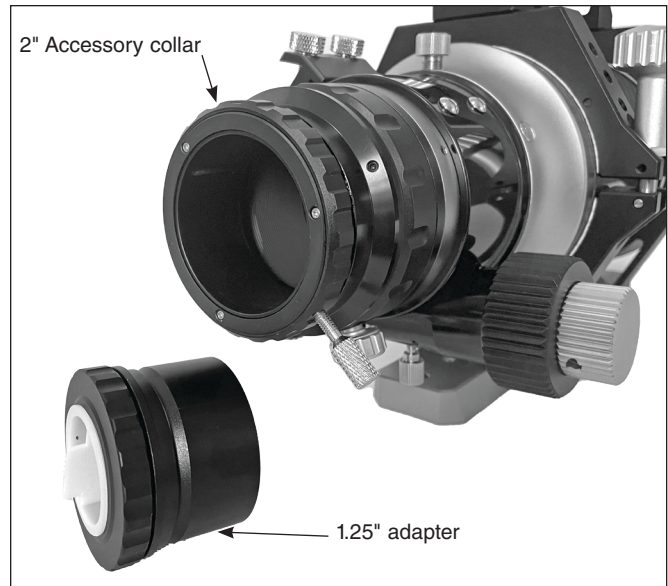


Figure 5. Both the 2" and 1.25" accessory collars feature a secure twist-tight locking mechanism.

Reaching Focus

Your EON ED90T CF apochromatic refractor must be used with either a diagonal or extension tube in order for an eyepiece to reach focus. We recommend using a 90° star diagonal (2" or 1.25") for visual use with an eyepiece. For astrophotography we recommend using a 2" field flattener designed for short-focal-length refractors, such as the Orion Field Flattener for Short Refractors (#8893), or our 0.8x Focal Reducer (#8894), which shortens the effective focal length and flattens the field. Even premium triplet refractors such as the ED90T CF need correction to provide a flat field so that stars are pinpoint sharp all the way to the edge of the photographic frame. That's just the nature of triplet optics. Optical flatteners are not needed or recommended for visual use.

Finder Scope Compatibility

Adding an optional finder scope to the EON ED90T CF is easy. The focuser is equipped with a dovetail finder scope shoe (see **Figure 1**) that accepts any Orion finder scope or reflex sight as well as the Orion Dual Finder Scope bracket (#10145). Alternatively, the finder scope shoe can be used to mount a small guide scope with a compatible bracket. Simply loosen the locking thumbscrew, slide your finder scope or guide scope in until it is fully seated, then lock the thumbscrew back down.

3. Operating the EON ED90T CF

The EON ED90T CF is a versatile telescope designed for both high-performance imaging and wide-field visual pursuits. Its fast f/6 focal ratio and ample 90mm (3.5") ED optics make it an especially powerful instrument for imaging with dedicated astronomical cameras or DSLR and mirrorless cameras.

Now that you have become familiar with the different features and functions of the telescope, you are ready to begin using your

new telescope outside under a starry sky. Be sure to allow the telescope to equilibrate to the outdoor temperature for at least 30 minutes before using it; this ensures the best, most stable image quality.

Connecting the EON ED90T CF to a Telescope Mount

The EON ED90T CF refractor comes with a pair of sturdy, hinged tube rings on the bottom of which a Vixen-style dovetail mounting bar is attached. On top of the rings a convenient carrying handle is pre-installed. The handle can be removed should you desire to instead install an optional dovetail plate on the tube rings for attachment of a second telescope or a guide scope, for instance. You will need a 5mm Allen wrench (not included) to remove the socket head cap screws attaching the handle to the rings.

On the top and bottom surfaces of the rings are multiple M6-1.0 tapped holes for attachment of dovetail plates. The handle, which is Arca-Swiss compatible, has three holes on top: the middle is ¼"-20 and it is flanked by two M6-1.0 holes.

Balancing the telescope can be done by moving the telescope within the tube rings to the extent possible, or by sliding the dovetail mounting plate forward or back in your mount's saddle.

Observing with the EON ED90T CF

To observe with the EON ED90T CF you will need either a 1.25" or 2" diagonal and an eyepiece, each sold separately. Because the optics are made with high-quality ED glass, the eyepieces you choose should also have excellent, fully multi-coated optics to utilize the full performance of the telescope. It is desirable to have a range of eyepieces of different focal lengths, to allow viewing over a range of magnifications.

To calculate the magnification, or power, of a telescope, simply divide the focal length of the telescope by the focal length of the eyepiece. The focal length of the ED90T CF is 540mm.

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

So an optional 20mm eyepiece would yield a magnification of $540/20 = 27\times$.

If outside viewing conditions are ideal, a telescope with good optics can achieve a magnification of about 60x per inch, or 2.4x per millimeter, of aperture. Keep in mind that at higher powers, an image will always be dimmer and less sharp (this is a fundamental law of optics). In most cases the steadiness of the air (the "seeing") will limit how much magnification the scope can tolerate, rather than the telescope itself.

Always start viewing with your lowest-power (longest focal length) eyepiece in the telescope. After you have located and observed the object with it, you can try switching to a higher-power eyepiece to ferret out more detail, if atmospheric conditions permit. If the image you see is not crisp and steady, reduce the magnification by switching to a longer focal length eyepiece. As a general rule, a small but well-resolved image will show more detail and provide a more enjoyable view than a dim and fuzzy, over-magnified image.

Imaging with the EON ED90T CF

Given its high-quality apochromatic optics and fast f/6.0 focal ratio, the EON ED90T CF excels for astrophotography with a dedicated astronomical CCD/CMOS camera or a DSLR or mirrorless camera. As mentioned previously

For optically fast refractors such as the EON ED90T CF, an optional field flattener is a desirable accessory to compensate for inherent field curvature. The flattener will ensure tight, sharp stars out to the edge of your imaging sensor, and is highly recommended if you are using a camera with an APS-C size sensor or larger. The Orion Field Flattener for Short Refractors (#8893) is a perfect match for this instrument.

Alternatively, our 0.8x Focal Reducer (#8894), which also flattens the image, can be used if you desire a wider imaging area. This focal reducer shortens the effective focal length of the EON ED90T CF from 540mm to 432mm, which changes the focal ratio from 6.0 to an even faster 4.8.

The Field Flattener and Focal Reducer adapters both have a backfocus distance of 55mm, measured from the rear surface of the adapter. Backfocus distance is the distance to reach the image plane, or focus point. You need to insure that your camera's sensor sits 55mm back from the rear surface of the adapter. For DSLRs and mirrorless cameras used with a standard 42mm or 48mm T-ring, the sensor distance will typically be 55mm. For astronomical cameras, the sensor usually sits closer to the front of the camera, so some additional spacing will be necessary between the field flattener or focal reducer and the camera to achieve the necessary 55mm backfocus. Orion offers 42mm T-ring extension rings (#5528) and 48mm extension rings (#52715) to help achieve focus with any number of different cameras. You'll want to get within about +/-2mm of the specified backfocus requirement to ensure a sharp image.

The 2.5" dual-speed rack-and-pinion focuser of the EON ED90T CF is capable of handling the weight of your CCD or DSLR camera and accessories, up to 19 lbs. The drawtube tension is set at the factory and should not need adjusting. After installing your camera equipment onto the focuser, check the focuser for any slippage. If it slips under the weight of the camera, you may need to add more tension to the focuser. Do this by lightly tightening the focuser tension thumbscrew (**Figure 4**).

Note About Chromatic Aberration

Chromatic aberration literally means color distortion. Whenever light passes through one material to another,

different wavelengths (color) are bent by different amounts. This is a problem that plagues refractor-type telescopes, since light passes through both air and glass to form an image. Most astronomical objects emit a spectrum comprised of many different wavelengths of light, so each wavelength will be bent by a slightly different amount when passing through a lens. This results in each color of light reaching precise focus at a slightly different point, which will provide a soft image with a halo of unfocused color.

The EON ED90T CF is designed to minimize chromatic aberration. The objective lens assembly comprises three individual lenses, one of which is made from high-performance Hoya FCD100 ED glass. The use of this ED glass minimizes the

amount of chromatic aberration, resulting in a much more pleasing view as compared to refractors that do not utilize ED glass. Critical stellar or planetary observations become more accurate with this color correction since the focus is sharper with no unfocused “false” color around the object. The ED optics will render true, high-contrast images.

4. Care & Maintenance

Give your telescope reasonable care and it will last a lifetime. When not in use, keep its dust cover on as well as the small plastic plug on the 1.25" adapter. Keep the telescope inside its case when not in use (**Figure 6**). Store it indoors or in a dry garage. Do not leave the telescope outside except when using it. If a scratch appears on the tube, it will not harm the telescope. Smudges on the tube can be wiped off with standard household cleaners.



Figure 6. The EON ED90T CF optical tube comes in a foam-fitted, hard carrying case.

Carbon Fiber Tube

Your Orion EON ED90T CF’s optical tube is made from carbon fiber material coated with an epoxy resin. This combination offers the benefits of high tensile strength and low weight as well as a low coefficient of thermal expansion and resistance to corrosion and wear. These properties make carbon fiber a widely used material in aerospace and automotive manufacturing.

Please use caution, however, in tightening the tube rings. Overtightening them could leave marks on the resin coating. Such marks are not covered by our warranty. Superficial marks and scuffs can be buffed out but deeper marks cannot be removed. So don’t crank those clamp knobs too tight!

Dealing with Dew

When you are ready to pack up your telescope at the end of the night, avoid immediately storing it if you encountered heavy dew and the telescope is damp. Likewise, if you bring the telescope indoors from colder temperature outdoors, moisture will form on the telescope’s surfaces and lens. In these cases allow the moisture on the telescope to evaporate. If dew forms on the objective lens, leave the dust cover off of the telescope until all the moisture has evaporated. Once the telescope has completely dried out, place it back in its case.

Cleaning Optical Surfaces

In general, your telescope will only need to be cleaned on a very minimal basis. Dust particles on the objective lens do not affect the optical quality of your EON ED90T CF. Loose dust can simply be blown off with air, using a photographer’s blower bulb. Any remaining dust is best left alone, unless the build up is extreme. Finger prints and water marks should be cleaned from your telescope’s objective lens. Any quality optical lens tissue and cleaning fluid specifically designed for multi-coated optics can be used to clean the telescope’s objective lens as well as the lenses of your eyepieces and finder scope. Never use regular glass cleaner or cleaning fluid designed for eyeglasses.

Before cleaning with fluid and tissue, blow any loose particles off the lens with a blower bulb or compressed air, or lightly brush the lens with a soft lens brush. Apply some cleaning fluid to a tissue, never directly on the optics. Wipe the lens gently in a circular motion, then remove any excess fluid with a fresh lens tissue. Oily fingerprints and smudges may also be removed using this method. Use caution; rubbing too hard may scratch the lens! Clean only a small area at a time, using a fresh lens tissue on each area. Never reuse tissues.

6. Specifications

Optical tube:	Carbon fiber/epoxy resin with anodized aluminum components
Optics design:	Air-spaced triplet
Lens cell:	Machined aluminum
Lens glass:	One element of Hoya FCD100 ED glass; two elements standard optical glass
Aperture:	90mm (3.5")
Focal length:	540mm
F-ratio:	6.0
Lens coatings:	Fully multi-coated (all air-to-glass surfaces multi-layer coated)
Backfocus distance:	147mm from 2" accessory collar to image plane
Tube baffles:	Knife edge baffle rings (x2); also baffled drawtube
Tube length, dew shield retracted:	17.75"
Tube length, dew shield extended:	19.5"
Dew shield outer diameter:	121.8mm (4.80")
Focuser:	2.5" Rack-and-pinion, CNC aluminum, 10:1 dual speed
Drawtube travel:	95mm (3.74")
Rotatable focuser:	Yes; thumbscrew lock
Focuser load capacity:	19 lbs.
Finder scope:	Dovetail shoe (with notch) pre-installed. Finder scope not included.
Camera angle adjustment:	Included; thumbscrew lock
Accessory collar:	2" twist-tight, self-centering
1.25" adapter:	Included; twist-tight collar
Tube rings:	Hinged, hexagonal, machined aluminum, felt lining, multiple M6-1.0 threaded holes, large hinged clamp knobs
Handle:	Aluminum Arca-Swiss compatible, one ¼"-20 hole and two M6-1.0 holes
Dovetail mounting bar:	Vixen style, 244mm length, red anodized; multiple thru holes and slot
Weight of telescope:	9 lbs. 12.4 oz.
Case:	Hard case with die-cut foam interior; outer dimensions 21" x 10" x 10"

One-Year Limited Warranty

This Orion product is warranted against defects in materials or workmanship for a period of one year from the date of purchase. This warranty is for the benefit of the original retail purchaser only. During this warranty period Orion Telescopes & Binoculars will repair or replace, at Orion's option, any warranted instrument that proves to be defective, provided it is returned postage paid. Proof of purchase (such as a copy of the original receipt) is required. This warranty is only valid in the country of purchase.

This warranty does not apply if, in Orion's judgment, the instrument has been abused, mishandled, or modified, nor does it apply to normal wear and tear. This warranty gives you specific legal rights. It is not intended to remove or restrict your other legal rights under applicable local consumer law; your state or national statutory consumer rights governing the sale of consumer goods remain fully applicable.

For further warranty information, please visit www.OrionTelescopes.com/warranty.



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