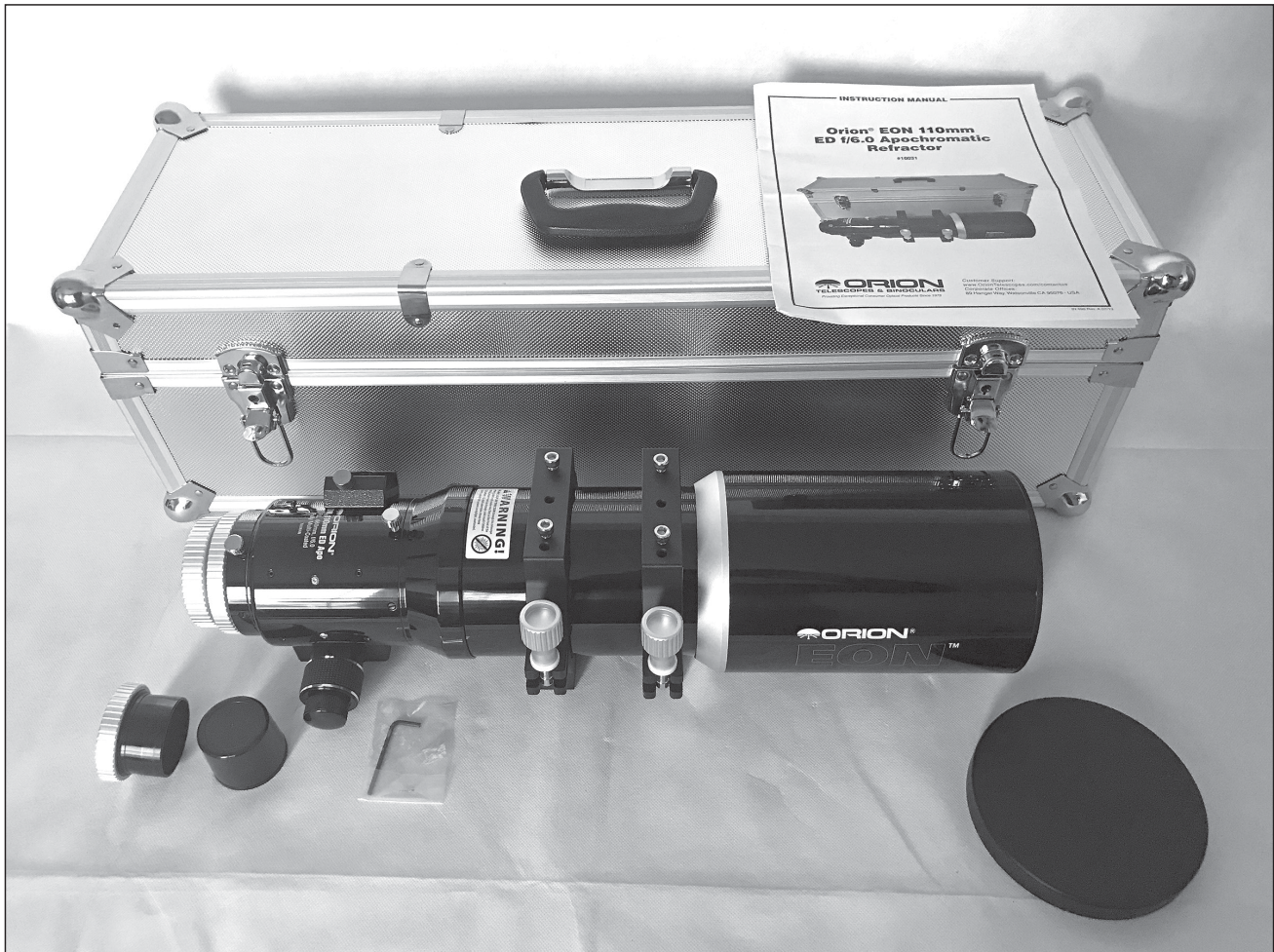


INSTRUCTION MANUAL

Orion® EON™ 110mm ED f/6.0 Apochromatic Refractor

#10031



 **ORION**
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Congratulations on your purchase of an Orion EON 110mm ED f/6.0 Apochromatic Refractor! Your telescope has been designed with high quality precision ED optics and superior mechanical construction. The 2.7" hybrid-design, dual-speed (11:1) Crayford focuser with linear bearings will rigidly support heavy 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.

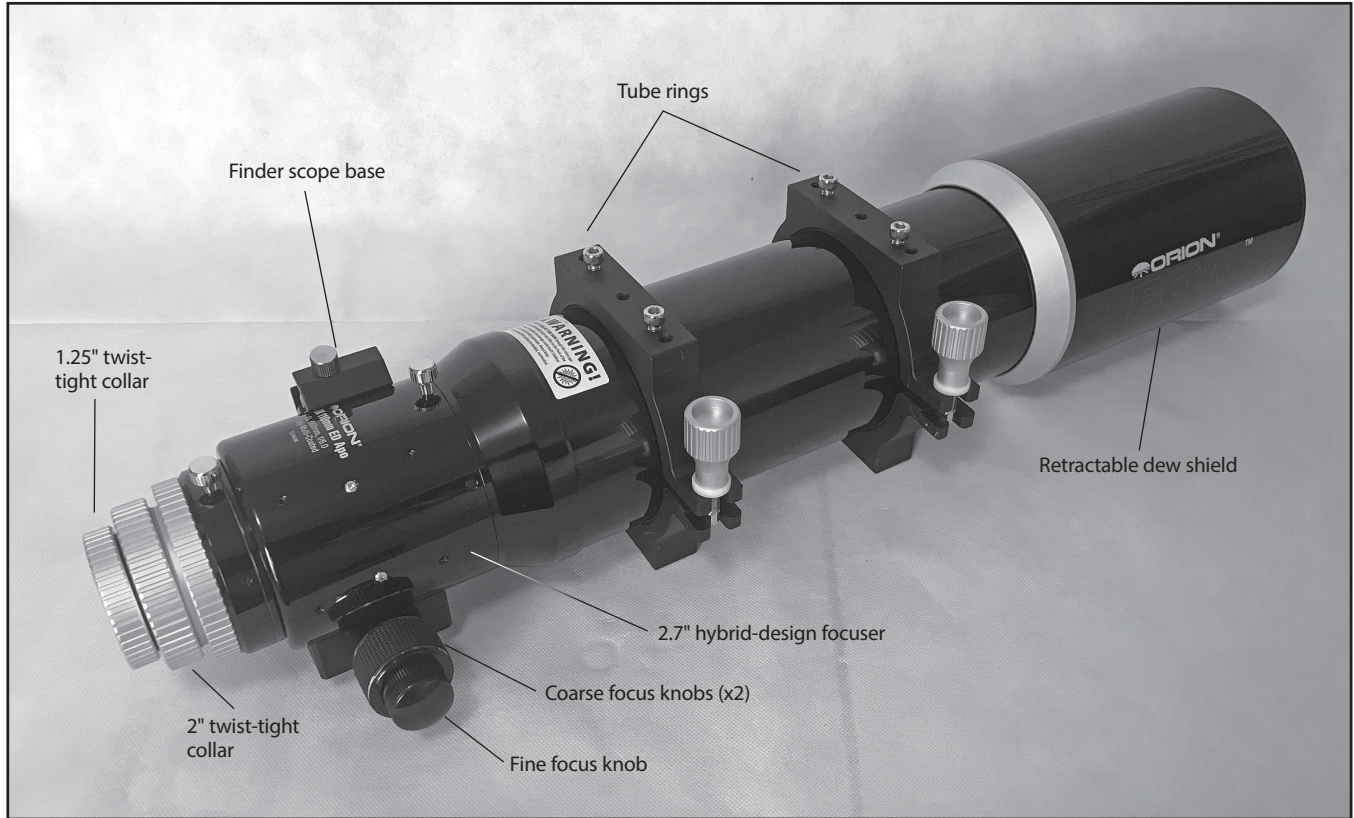


Figure 1. Features and components of the EON 110 ED F/6.0 Apochromatic Refractor

WARNING: NEVER look directly at the Sun through your telescope—even for an instant—without a professionally made solar filter that completely covers the front of the instrument, or permanent eye damage could result. Young children should use this telescope only with adult supervision.

Parts List

- EON 110mm ED f/6.0 optical tube assembly
- Aluminum objective cap
- 1.25" twist-tight adapter
- Tube rings (pair)
- Hard carrying case
- 2.5mm hex key

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Getting Started

The EON 110mm ED 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.

Features and Functions

The EON 110 ED 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.

“Extra-Low Dispersion” (ED) Doublet Optics

The EON 110 ED utilizes high-end doublet optics designed to minimize chromatic aberration. The objective lens assembly comprises two individual lenses, the crown (front) element, and flint (rear) element. The flint glass element is made from FPL-51 ED glass, made by Ohara of Japan. The “ED” stands for “Extra-Low Dispersion.” The use of this ED glass minimizes chromatic dispersion, or the amount of chromatic aberration, resulting in a much sharper image free of color fringing. Critical stellar or planetary observations become more accurate with this color correction since the focused images are free of “false” color halos around the object.

Retractable Dew Shield

The dew shield of the EON 110 ED is retractable, allowing the telescope to become more compact for storage. With the dew shield extended, the scope is 26.75" long; with the dew shield retracted, the length reduces to 21.75". 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. To extend the dew shield, simply pull it forward until it stops.

Dual-Speed 2.7" Hybrid-Design Linear Bearing Focuser

Focusing the EON 110 ED is truly a joy, thanks to the all-machined, 2.7" hybrid-drive linear bearing focuser (**Figure 2**). And for imaging, where a focuser's rigidity to support one's imaging equipment without flexure or slippage is critical, this focuser makes the grade. The hybrid design rack-and-pinion linear bearing focuser provides exceptionally smooth, backlash-free focus motion. The helical gear drive and 8 ball bearing

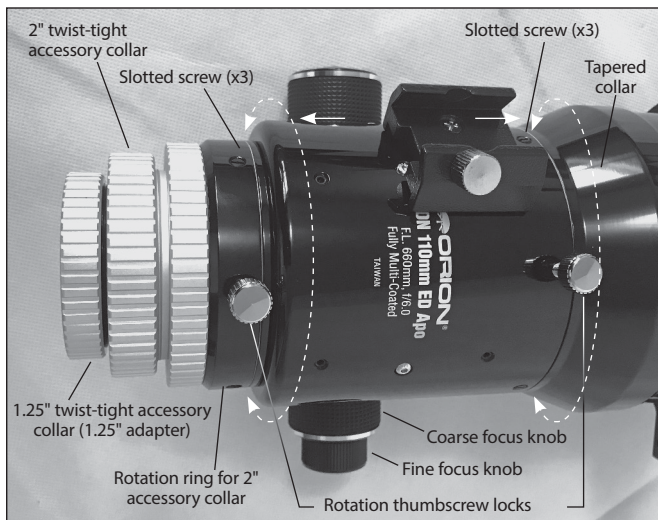


Figure 2. The 2.7" dual-speed, hybrid-drive focuser has two rotatable components.

linear-bearing system enables the focuser to support up to a hefty 8kg (17.6 lbs.) of payload -- such as a large format CCD camera, filter wheel, and other accessories. The patented focus lock mechanism locks the drawtube in two directions, providing a much more rigid lock than the single-point locking mechanism found on most focusers. The lock knob is located on the underside of the focuser (**Figure 3**).

The dual-speed (11:1) 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 (**Figure 2**) offers an 11:1 fine focus adjustment (11 turns of the fine focus knob equals one

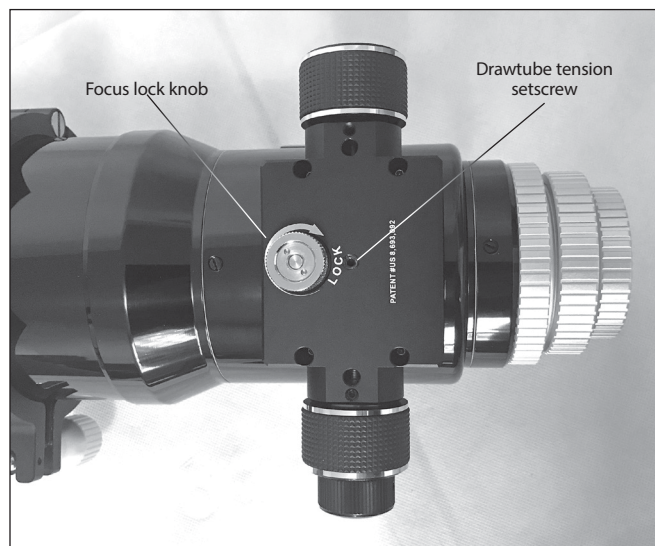


Figure 3. The underside of the focuser features a focus lock knob and drawtube tension setscrew.

turn of the coarse focus knob).

If you find that the focus adjustment is too hard to turn 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 setscrew located on the bottom side of the focuser (**Figure 3**). 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 latest release of the EON 110mm ED features a 2" twist-tight collar and a 1.25" twist-tight adapter (**Figure 4**). The twist-tight mechanism replaces and is superior to conventional collars that utilize a thumbscrew to secure accessories to the focuser. Thumbscrews can sometimes fall out and get lost, and are harder to grip in the cold when wearing gloves. The twist-tight mechanism provides an extremely secure attachment with just a twist of the large knurled collar. Both collars have a non-marring internal compression ring for securing a diagonal,

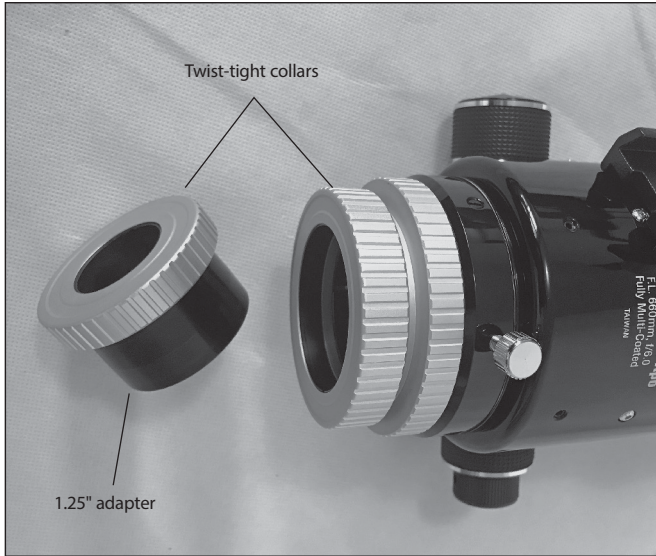


Figure 4. New to this edition of the EON 110 ED are twist-tight 2" accessory collar and 1.25" adapter with twist-tight collar.

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 1.25" adapter has a tapered barrel, which provides an even more secure fit into the 2" collar, such that even a slight, inadvertent loosening of the 2" collar will not result in the 1.25" adapter slipping out.

Engraved Millimeter Scale on Focuser Drawtube

The drawtube of the EON 110 ED's focuser features a laser-engraved millimeter scale on top (Figure 5), which aids in providing repeatable focus. When precise focus is achieved, noting the value on the scale where the drawtube meets the focuser

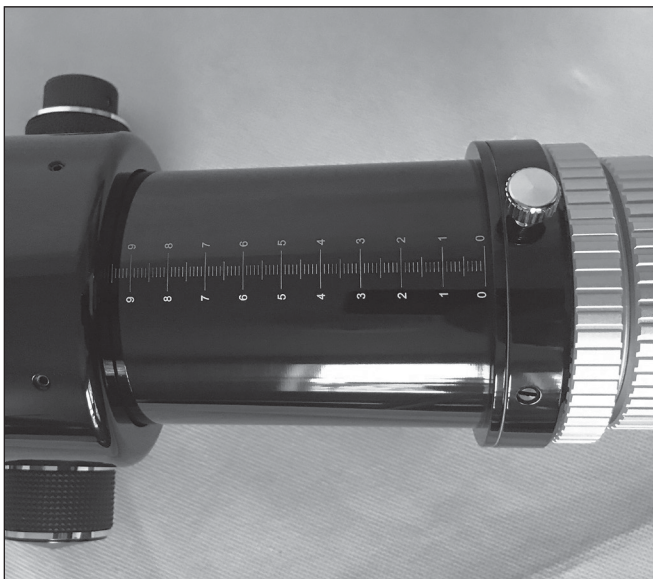


Figure 5. The engraved millimeter scale on the focuser aids in quickly achieving repeatable focus.

housing will allow you to return to approximately the same point, such as when focusing the same a camera in subsequent imaging sessions. Using the scale can save time compared to finding the focusing point "from scratch."

Focuser Rotation

The focuser on the EON 110 ED has two rotatable components. The entire focuser can be rotated just behind the tapered collar where the focuser attaches to the optical tube (see Figure 2). The second point of rotation is the rotation ring for 2" accessory collar behind the focus knobs. Both of the rotation mechanisms have three recessed, slotted screws that must be slightly loosened to permit rotation, as well as a thumbscrew lock.

Why two points of rotation? Rotating the entire focuser will reorient 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. Rotating the rotation ring for the 2" accessory collar, additionally, may be useful for framing a target object for imaging.

To rotate the focuser, loosen the rotation lock thumbscrew (Figure 2) a turn or so counterclockwise. Gently rotate the focuser to the desired orientation, then lock it in place by turning the lock thumbscrew clockwise. If you find the focuser is difficult to rotate, you may have to very slightly loosen the three slotted screws around the focuser with a small flat-blade screwdriver (not included). If, on the other hand, you feel too much "play" in the focuser when the thumbscrew is loosened, you may need to tighten the slotted screws a bit. You want the focuser to be able to rotate but without play.

Reaching Focus

Your EON 110mm ED apochromatic refractor must be used with either a diagonal or extension tube in order for an eyepiece to reach focus. In most cases, you will be using a 90° star diagonal for visual use with an eyepiece. A camera will also likely require a 2" extension adapter to reach focus. An optional 2" field flattener designed for short-focal-length refractors, such as the Orion Field Flattener for Short Refractors (#8893), can be used instead of an extension adapter.

Finder Scope Compatibility

Adding an optional finder scope to the EON 110 ED is easy. The focuser is equipped with a dovetail finder scope base (see Figure 1) that accepts any Orion finder scope or reflex sight as well as the Orion Dual Finder Scope bracket (#10145).

Operating the EON 110mm ED

The EON 110mm ED is a versatile telescope designed for both high-performance imaging and wide-field visual pursuits. Its fast f/6 focal ratio and ample 110mm ED optics make it an especially powerful instrument for imaging with CCD or DSLR 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 ½ hour before using it; this ensures the best image quality.

Connecting the EON 110mm ED to a Telescope Mount

The EON 110mm ED refractor comes with a pair of sturdy, hinged tube rings. On the top and bottom bosses of the rings are multiple M6-0.75 tapped holes for attachment of dovetail plates. Four M6-0.75 socket head cap screws are included with the rings. You will need one dovetail plate on the bottom to couple the telescope to your mount's dovetail saddle. You may also want to mount another plate on top for attachment of a guide scope for imaging.

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

Observing with the EON 110 ED

To observe with the EON 110 ED 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:

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

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 110 ED

Given its high-quality, apochromatic optics and fast f/6.0 focal ratio, the EON 110 ED excels for astrophotography with a CCD or DSLR camera. To attach a DSLR camera, all you will need is the appropriate T-ring for the make and model of your camera, a 2" prime focus camera adapter, and a 2" extension tube (available from Orion). Simply attach the T-ring to the camera body and thread the 2" prime focus camera adapter into the

T-ring. Insert the barrel of the camera adapter into the 2" extension tube, then install the 2" extension tube in the 2" twist-tight accessory collar of the focuser and rotate it clockwise to tighten.

Most CCD cameras will have a 1.25" or 2" barrel ready to attach directly to your telescope like an eyepiece or diagonal. No adapter is required, simply insert the barrel of the CCD camera into the 1.25" twist-tight adapter or 2" twist-tight collar and rotate it clockwise to tighten. Depending on your camera, you may need to use an extension tube for your particular imaging setup. Any imaging accessory, such as a color filter wheel, increases the amount of inward focus travel required.

For optically fast refractors such as the EON 110 ED, 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.

Before attaching any extra imaging accessory, try reaching focus first with the camera directly attached to the focuser, then see if you have enough inward focus travel left for extra accessories.

The hybrid-drive, 2.7" dual-speed focuser of the EON 110 ED is capable of handling the weight of your CCD or DSLR camera and accessories, up to 17.6 lbs. (8Kg). 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 drawtube tension setscrew (**Figure 3**).

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 110's high quality ED optics are designed to minimize chromatic aberration, resulting in a much sharper, more pleasing view as compared to refractors that do not utilize ED glass.

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 110 optical tube comes in a foam-fitted, aluminum-clad carrying case.*

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. Instead, bring the telescope inside and allow the moisture on the telescope to evaporate. If dew forms on the objective lens, then 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 110 ED. Loose dust can simply be blown off with air, using a compressed air can or a photographer's blower bulb. Any remaining dust is best left alone, unless the build up is extreme. Fingerprints 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, however, blow any loose particles off the lens with a blower bulb or compressed air, or lightly brush the lens with a soft camel hair 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 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.

Specifications

Optical tube:	Seamless aluminum
Optics design:	Air-spaced doublet
Lens cell:	Machined aluminum
Lens glass:	ED S-FPL51 and S-NBM51
Aperture:	110mm
Focal length:	660mm
F-ratio:	6.0
Lens coatings:	Fully multi-coated (all air-to-glass surfaces multi-layer coated)
Tube baffles:	Knife edge baffles (x3)
Tube length, dew shield retracted:	21.75" / 552mm
Tube length, dew shield extended:	26.75" / 679mm
Dew shield outer diameter:	5.32" / 135.2mm
Weight:	11 lbs. 10.8 oz. (with tube rings attached)
Tube rings:	Hinged, felt lining, three 1/4"-20 holes on upper and lower bosses
Focuser:	2.7" Hybrid drive, linear bearings with 8 ball bearings; 11:1 dual speed
Focuser weight capacity:	17.6 lbs. / 8kg
Drawtube travel:	3.74" / 95mm
Rotatable focuser:	Yes
Focus lock:	Patented design, locks in two directions
Finder scope:	Optional
Accessory collar:	2" twist-tight with self-centering brass compression ring
1.25" adapter:	Included; twist-tight collar, brass compression ring, tapered barrel
Diagonal:	Not included
Eyepiece:	Not included
Field flattener:	Optional
Case:	Aluminum clad with die-cut foam interior; outer dimensions 28.25" x 9.25" x 9.75" / 718mm x 235mm x 247mm

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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