

## INSTRUCTION MANUAL

# Orion® EON™ Apochromatic ED Refractors

#9781 EON 72mm, #9927 EON 80mm, #9925 EON 120mm

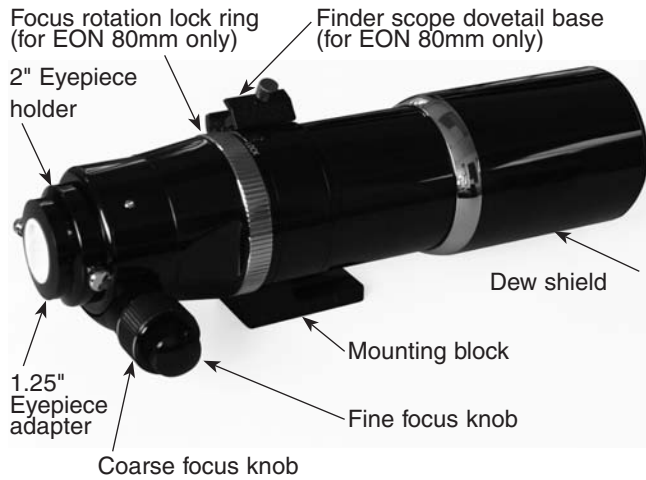


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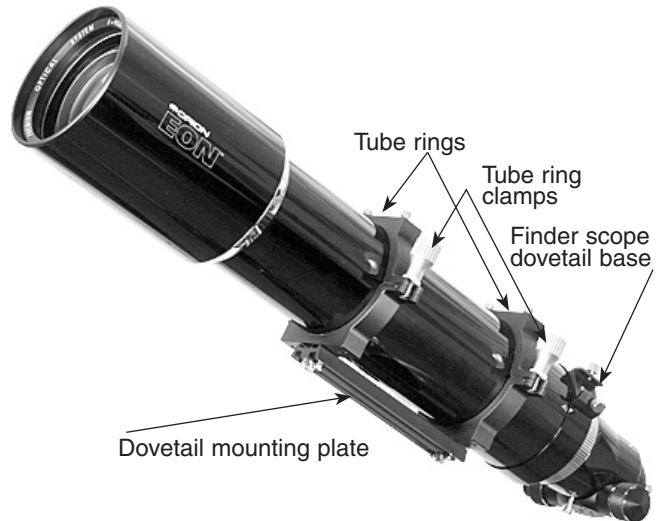
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Congratulations on your purchase of an Orion® EON™ ED Apochromatic Refractor optical tube assembly. The exceptional optical and mechanical quality of your EON refractor will provide you with a pleasing telescope experience. The ED glass in the objective lens yields extremely sharp, high-contrast images with virtually no color distortion compared to a standard refractor. The smooth and fine movement of the dual-speed Crayford focuser allows for easy and precise focusing. These instructions will help you use your EON refractor optical tube assembly.



**Figure 1a.** The EON 72mm and 80mm ED Refractor optical tube assembly



**Figure 1b.** The additional features of the EON 120mm ED Refractor optical tube assembly

## Parts List

### EON 72mm & 80mm

Optical tube assembly

Dust Cover

1.25" eyepiece adapter

2.5mm hex key

Hard carrying case

### EON 120mm

Optical tube assembly

Dust Cover

1.25" eyepiece adapter

Tube rings (quantity 2)

Dovetail mounting plate

2.5mm hex key

Hard carrying case

## Getting Started

Your EON refractor is fully assembled from the factory. The optics have been installed and collimated, so you do not need to make any adjustments to them.

We recommend keeping all of the original packaging. In the unlikely event you should need to ship the telescope back to Orion for warranty repair service, you should use the original packaging to ensure the telescope stays intact during shipping.

Take a moment to inspect the telescope and all of its parts.

## Functions and Features

The EON refractors have several features designed to maximize the use and enjoyment of your telescope. When you have become familiar with all of the functions of your EON refractor, you will be ready to begin using your new telescope under the night sky!

### Retractable Dew Shield

All EON refractors feature a retractable dew shield which allows the telescope to become more compact for storage. The dew shield's primary purpose is to prevent dew (water condensation) from forming on the lens during cold and humid nights. The dew shield is also useful for reducing glare under unwanted outside lights. To extend the dew shield, remove the optical tube dust cover, then pull the dew shield outward until it stops (Figure 2).



**Figure 2.** Gently pull the dew shield outward until it stops.

## 2" Dual-Speed Crayford Focuser

The high quality dual-speed 2" Crayford focuser is one of the most important components of your EON refractor. The Crayford design allows for smooth, precise focusing without any image shift that typical rack-and-pinion designs experience.

For quick focusing of your EON refractor, the two larger focus knobs will provide a coarse focus. For more precise focusing, as needed for applications such as critical high power planetary observing and digital imaging, the smaller black focus knob (Figure 1a) offers fine adjustment. The fine focus knob rotates eleven times to one single rotation of the coarse focus knobs, making an 11:1 ratio for extremely precise focusing.

The dual-speed Crayford is capable of handling the weight of heavy accessories, such as large 2" eyepieces or a CCD or DSLR camera. Adding tension to the focuser drawtube will further increase the amount of weight the focuser can handle without slipping. To adjust the focuser drawtube tension, locate the focus tension set screw on the underside of the focuser (Figure 3). Using the 2.5mm hex key, turn the set screw clockwise until you have added the appropriate amount of tension for your needs. In some cases, you may want to loosen the tension, which will also decrease the resistance of the focus knob movement. Simply turn the focus tension set screw counter-clockwise as needed to loosen the focus drawtube tension.

Tightening the focus lock thumbscrew (Figure 3) will prevent the drawtube from moving. This feature can be utilized for imaging, or visual use, when you have achieved focus and do not want the drawtube to move. While you are focusing, make sure the focus lock thumbscrew is loosened, or the drawtube may not move properly.

*Note: Applying too little tension on the focuser will result in the focus drawtube to slide under its own weight, or under the weight of your accessories installed. Make sure there is enough tension to support your 2" or 1.25" accessories.*

## Focuser Rotation

The focuser assembly on the EON refractors have the ability to be rotated. Under normal use, you should not have to rotate the focuser, since the eyepiece and diagonal can be rotated instead. However, focuser rotation can be beneficial for changing the camera orientation while imaging (see "Imaging with the EON Refractors"). Additionally, this feature can allow you to keep the focus knobs parallel to the ground no matter how your telescope is positioned. This can be especially convenient when the telescope is mounted in different orientations, causing the focus knob orientation to change.

To rotate the focuser, turn the focus rotation lock ring (Figure 1a) counter-clockwise until the assembly loosens. Rotate the focuser to the desired orientation. Lock the focuser in place by turning the focus rotation lock ring clockwise. To ensure a secure lock, it is sometimes necessary to grab hold of the entire focuser assembly and firmly rotate it clockwise, bracing your other hand against the stationary portion of the optical tube.

The 72mm EON refractor has screw holes for an optional finder scope dovetail base attached to the rotating portion of the focuser, allowing you to change the orientation of the finder scope as desired.

The EON 72mm uses a single thumbscrew instead of a lock ring to lock the focuser rotation. To rotate the focuser on the EON 72mm, loosen the focuser rotation lock thumbscrew and rotate the focuser to the desired orientation. Lock the focuser in place by tightening the focuser rotation lock thumbscrew.



**Figure 3.** Adjustments can be made to the focus tension set screw using the provided 2.5mm hex key. Tightening the focus lock thumbscrew will stop the focuser drawtube from moving.

## Using 1.25" and 2" Accessories

Your EON refractor can accommodate both 1.25" and 2" accessories, including just about any eyepiece, diagonal, or camera. The Crayford focuser has a 2" eyepiece holder with a 1.25" eyepiece adapter installed (Figure 4). Both the 2" eyepiece holder and 1.25" eyepiece adapter feature a brass compression ring to hold your accessories in place. The brass compression ring securely holds the 1.25" or 2" accessory in place without marking its metal barrel.

The telescope must be used with either a diagonal or extension tube in order for the eyepiece to reach focus. In most cases, you will be using a 90° star diagonal for visual use with an eyepiece.

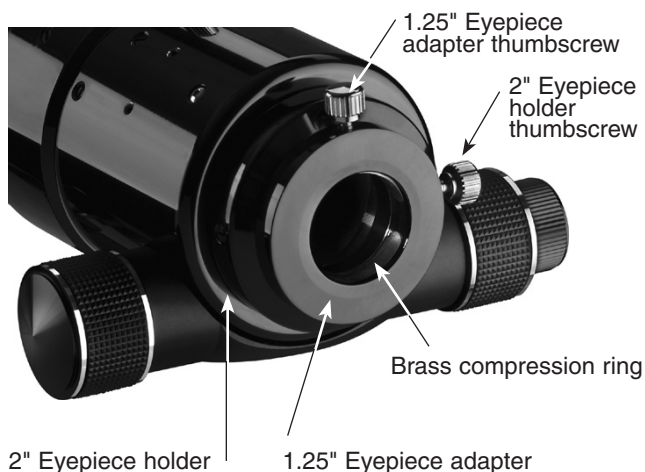
To attach a 1.25" diagonal or extension tube to your telescope:

1. Remove the dust cap from the 1.25" eyepiece adapter.
2. Insert the barrel of your diagonal or extension tube into the 1.25" eyepiece adapter.

3. Secure the barrel in place by firmly tightening the thumbscrew on the 1.25" eyepiece adapter.

To attach a 2" diagonal or extension tube to your telescope:

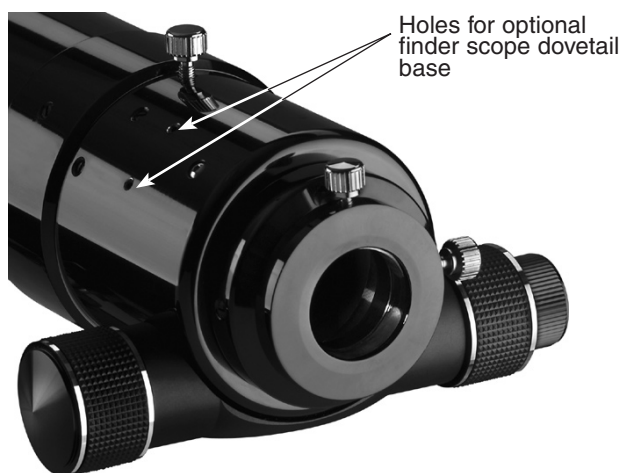
1. Loosen the thumbscrew on the Crayford focuser's 2" eyepiece holder and remove the 1.25" eyepiece adapter.
2. Insert the barrel of your diagonal or extension tube into the 2" eyepiece holder.
3. Secure the barrel in place by firmly tightening the thumbscrew.



**Figure 4.** The EON refractors accept both 1.25" and 2" accessories. The brass compression rings in the 1.25" eyepiece adapter and 2" eyepiece holder ensure a secure fit without marking up the barrel of your accessory.

### Finder Scope Compatibility

The included finder scope dovetail base on the EON 80mm and 120mm refractors are ready to accept any Orion finder scope. The EON 72mm does not include a finder scope dovetail base; however, it is available optionally from Orion and directly fits the holes in the EON 72mm (Figure 5).



**Figure 5.** The EON 72mm is compatible with the Orion finder scope dovetail base.

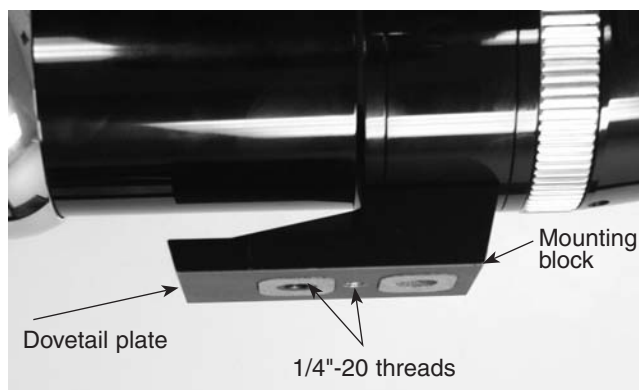
To insert a finder scope onto your EON refractor, slide the finder scope bracket into the finder scope dovetail base and secure it in place by tightening the thumbscrew(s) on the dovetail base (Figure 6).



**Figure 6.** Slide the finder scope bracket into the finder scope dovetail base and secure the locking thumbscrew(s).

## Operating the EON Refractor

Now that you have become familiar with the different features and functions of your EON refractor, you are ready to begin using your new telescope outside under a starry night. The EON refractors are essentially ready to begin observing with immediately. There is a small period of time where the internal temperature of the telescope must match the outside temperature to obtain the best image quality. This time period is nearly nominal, taking only a few minutes. Typically, the EON will have reached outside temperature by the time the telescope is setup.



**Figure 7.** The EON 72mm and 80mm have a built-in mounting block ready to connect to a sturdy camera tripod or telescope mount.



### Connecting the EON 72mm and 80mm to a Tripod or Mount

The EON 72mm and 80mm have a built-in mounting block ready to connect to a sturdy camera tripod or telescope mount (Figure 7). The mounting block is threaded to accept a common 1/4"-20 stud found on almost any camera tripod. To connect the EON 72mm or 80mm to a camera tripod, simply screw the 1/4"-20 stud found on your camera tripod to the underside of the EON's mounting block. The EON 72mm has three different holes to choose from, and the EON 80mm has two holes. Pick the 1/4"-20 hole that provides the best balance on your tripod.

The mounting block also functions as a dovetail plate which is compatible with many Orion telescope mounts. The dovetail plate is also compatible with many other mounts. To connect the EON 72mm or 80mm to a telescope mount, loosen the attachment screw(s) on the mount's dovetail holder until the screw(s) provides enough clearance for the dovetail mounting plate. Align the mounting block with the dovetail holder and slide it forward (Figure 8). Tighten the attachment screw(s) on the dovetail holder of the mount.



**Figure 8.** Align the mounting block with the dovetail holder and slide it forward. Tighten the attachment screw(s) on the dovetail holder of the mount.

For the best stability and motion on your mount, the EON should be balanced front to back. If you are using the mounting block as a dovetail plate, then balancing the EON simply requires sliding the telescope forward or backward in the dovetail holder as needed. Loosen the attachment screw(s) on your mount just enough to free the dovetail plate, then reposition the telescope and retighten the screw(s).

If you are using a camera tripod or telescope mount and need additional balance adjustment, the orientation of the mounting block can be reversed. This is especially helpful

when using heavy accessories, such as 2" eyepieces or DSLR cameras. To reverse the orientation of the mounting block, remove the screw (using a 4mm hex key) that attaches the mounting block to the telescope tube and turn it around 180° (Figure 9). Once the mounting block orientation has been reversed, reattach the screw.



**Figure 9.** For a greater range of balance on the EON 72mm and 80mm, switch the direction of mounting block using a 4mm hex key.

### Connecting the EON 120mm to a Mount

The EON 120mm refractor includes a preinstalled pair of tube rings and a dovetail mounting plate, ready to attach to a heavy-duty telescope mount. The dovetail plate is compatible with many Orion telescope mounts. The dovetail plate is also compatible with many other available mounts. To connect the EON 120mm to a mount, loosen the attachment screw(s) on the mount's dovetail holder until the screw(s) provide enough clearance for the dovetail mounting plate. Carefully place the dovetail plate flat against the top surface of the dovetail holder of the mount and tighten the attachment screw(s) securely.

Balancing the EON 120mm can be achieved by sliding the dovetail mounting plate forward or backward within the mount's dovetail holder. You can also move the telescope forward or backward within the tube rings. The tube rings offer the most adjustment range. Loosen the tube ring clamps (Figure 1b) slightly and slide the telescope tube forward or backward as needed to reach optimum balance, then retighten the tube ring clamps.

## Using Different Eyepieces

The EON refractors work well with virtually any 1.25" or 2" eyepiece. Because the EON refractors implement high-quality ED optics, the eyepieces you use should also have excellent, fully multi-coated optics to utilize the full performance of the EON. The diagonal used should also be a quality 90° mirror with high reflectivity.

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:

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

For example, the EON 80mm ED, which has a focal length of 500mm, used in combination with a 25mm eyepiece, yields a power of 20x.

$$\frac{500\text{mm}}{25\text{mm}} = 20\text{x}$$

If all outside viewing conditions are ideal, every telescope with good optics supports a maximum 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.

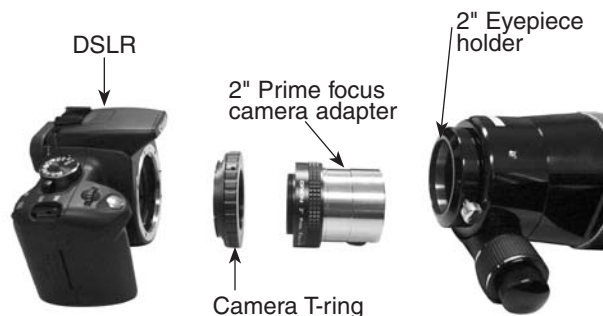
## Imaging with the EON Refractors

The EON refractors make very capable astrographs for your 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, and a 2" prime focus camera adapter (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" eyepiece holder on the EON focuser (Figure 10), and secure it with the thumbscrew.

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" or 2" eyepiece holder and secure the camera with the thumbscrew.

The EON ED refractors were designed to reach focus with both DSLR and CCD cameras. However, every camera's focus point is a little different. 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. 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.



**Figure 10.** To attach a DSLR camera, attach the T-ring to the camera body, then thread the camera adapter to the t-ring. Insert the camera adapter barrel into the 2" eyepiece holder on the focuser and tighten the attachment thumbscrew.

Imaging equipment is sometimes heavier than a diagonal and eyepiece. The dual-speed Crayford focuser is capable of handling the weight of your CCD or DSLR camera. Adding tension to the focuser drawtube will increase the amount of weight the focuser can handle. Install your camera onto the focuser during the day. Check the focuser for any slippage. If the focuser drawtube slips under the weight of the camera, you will need to add more tension to the focuser by tightening the focus tension set screw.

## 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 is designed to minimize chromatic aberration. The objective lens is actually comprised of two individual lenses, the crown (front) element, and flint (rear) element. The EON features a flint glass element made of high-performance 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 have ED glass. Critical stellar or planetary observations become more accurate with this color correction since the focus is sharper with no unfocused "false" or unwanted color around the object. The ED optics will render true, high-contrast images.

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## 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 dust cap on the eyepiece opening. Keep the telescope inside the hard storage carrying case when not in use. Store it indoors or in a dry garage. Do not leave the telescope outside except when using it. The optical tube is aluminum and has a smooth anodized surface that should resist scratches and smudges. If a scratch does appear on the tube, it will not harm the telescope. Smudges on the tube can be wiped off with standard household cleaners.

### Dew

When you are ready to pack up your telescope at the end of the night, avoid immediately storing it in the hard case 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 in the hard 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 effect the optical quality of your EON. Loose dust can simply be blown off with air, using a compressed air can or blower bulb (available from Orion). 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, 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

### EON 72mm ED Apochromatic Refractor

Optical tube:	Seamless aluminum
Objective lens:	Apochromatic, rear element made of FPL-51 ED glass, air-spaced
Objective lens coating:	Fully multi-coated
Lens cell:	Machined aluminum
Focal length:	430mm
Focal ratio:	f/6.0
Baffles:	2 knife-edge baffles

Focuser:	Dual Speed 11:1 Crayford, accepts 1.25" or 2" accessories, brass compression ring
Mounting:	Mounting block, dovetail design, 1/4"-20 threaded
Weight:	5.0 lbs./2.27 kg
Length:	12.5"/31.75cm with dew shield retracted
Outside Diameter:	3.43"/87mm

### EON 80mm ED Apochromatic Refractor

Optical tube:	Seamless aluminum
Objective lens:	Apochromatic, rear element made of FPL-53 ED glass, air-spaced
Objective lens coating:	Fully multi-coated
Lens cell:	Machined aluminum
Focal length:	500mm
Focal ratio:	f/6.25
Baffles:	Cone baffle
Focuser:	Dual Speed 11:1 Crayford, accepts 1.25" or 2" accessories, brass compression ring
Mounting:	Mounting block, dovetail design, 1/4"-20 threaded
Weight:	6.5 lbs./2.95 kg
Length:	15.25"/38.74cm with dew shield retracted
Outside Diameter:	3.54"/90mm

### EON 120mm ED Apochromatic Refractor

Optical tube:	Seamless aluminum
Objective lens:	Apochromatic, rear element made of FPL-53 ED glass, air-spaced
Objective lens coating:	Fully multi-coated
Lens cell:	Machined aluminum
Focal length:	900mm
Focal ratio:	f/7.5
Baffles:	3 knife-edge baffles
Focuser:	Dual Speed 11:1 Crayford, accepts 1.25" or 2" accessories, brass compression ring
Mounting:	Tube rings and dovetail plate
Weight:	14.31 lbs./6.49 kg
Length:	31.25"/79.38cm with dew shield retracted
Outside Diameter:	3.54"/122mm

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## **One-Year Limited Warranty**

The Orion EON Refractor 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 to: Orion Warranty Repair, 89 Hangar Way, Watsonville, CA 95076. Proof of purchase (such as a copy of the original receipt) is required.

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, and you may also have other rights, which vary from state to state. For further warranty service information, contact: Customer Service Department, Orion Telescopes & Binoculars, 89 Hangar Way, Watsonville, CA 95076; (800) 676-1343.