INSTRUCTION MANUAL

Orion®
SpaceProbe™ 3 Altaz

#9883 Altazimuth Refractor Telescope

TELESCOPES & BINOCULARS

Providing Exceptional Consumer Optical Products Since 1975

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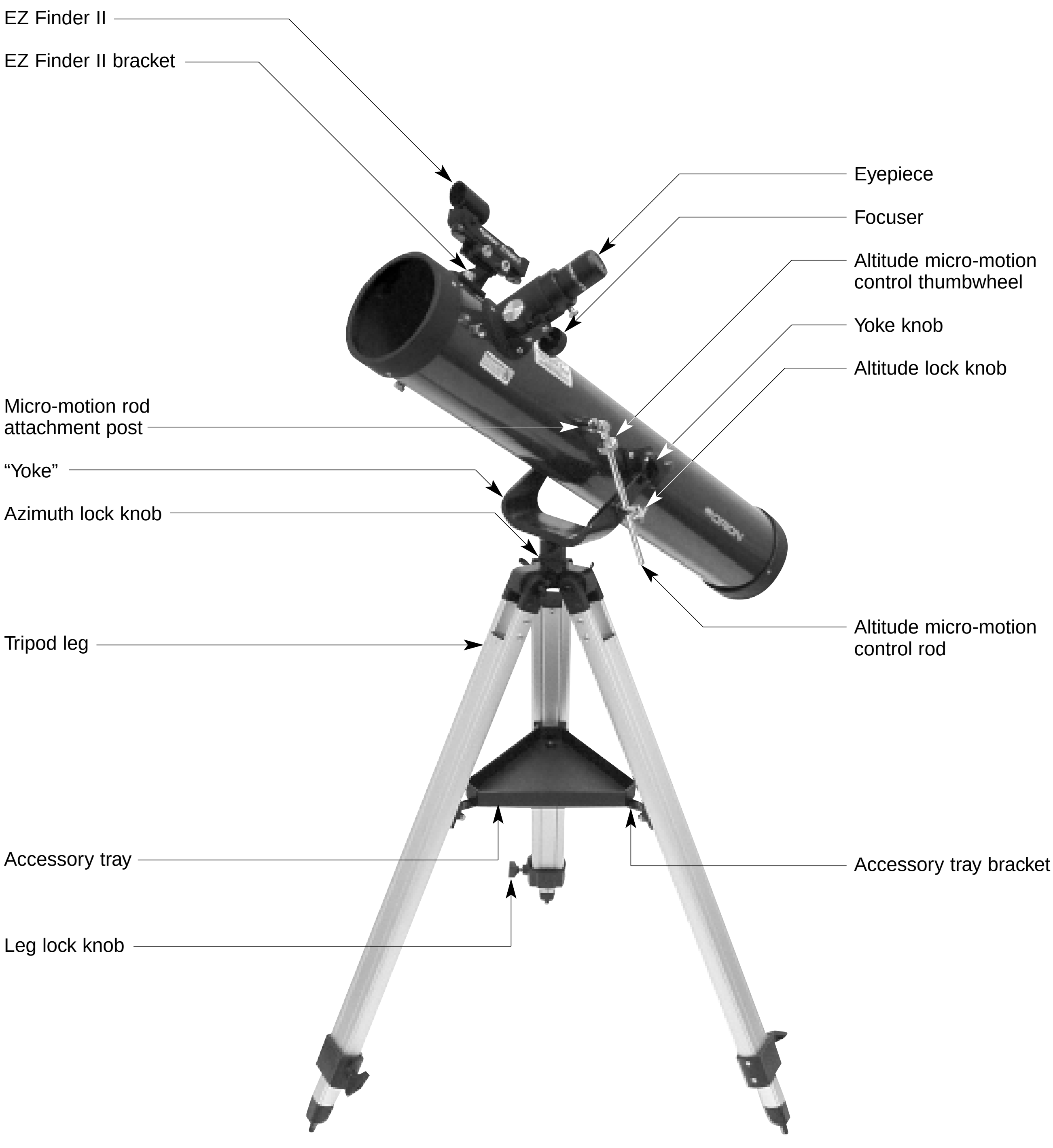

Figure 1. The SpaceProbe 3 AZ.

Welcome to the exciting world of amateur astronomy! Your SpaceProbe 3 Altazimuth Reflector is a high-quality optical instrument designed for nighttime stargazing. With its precision optics and intuitive altazimuth mount, you'll be able to locate and enjoy fascinating denizens of the night sky, including the planets, Moon, and a variety of deep-sky objects. Lightweight and easy to use, this scope will provide many hours of enjoyment for the whole family.

These instructions will help you set up, properly use, and care for your telescope. Please read them over thoroughly before getting started.

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1. Unpacking

The entire telescope system will arrive in one box. Be careful unpacking the box. We recommend keeping all of the original packaging. In the event that the telescope needs to be shipped to another location, or returned to Orion for warranty repair, having the proper packaging will help ensure that your telescope will survive the journey intact.

Make sure all the parts in the Parts List are present. Be sure to check the box carefully, as some parts are small. If anything appears to be missing or broken, immediately call Orion Customer Support (800-676-1343) for assistance.

Warning: Never look at the sun with your telescope or its finderscope—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.

2. Parts List

Qty.	Description
1	Optical tube assembly
1	Altazimuth yoke mount
1	Altitude micro-motion rod with thumbwheel
3	Tripod legs with accessory tray bracket attached
1	EZ Finder II reflex sight and mounting bracket
1	Accessory tray
3	Tripod attachment screws with wing nuts and washers
3	Leg lock knobs
2	Yoke knobs
3	Accessory tray attachment wingscrews with lock nuts and washers
1	25mm Explorer II eyepiece
1	10mm Explorer II eyepiece
1	Dust cover
1	Collimation cap

3. Assembly

Assembling the telescope for the first time should take about 30 minutes. You will need a Phillips head screwdriver and a flat head screwdriver. All screws should be tightened securely to eliminate flexing and wobbling, but be careful not to over-tighten or the threads may strip. Refer to Figure 1 during the assembly process.

During assembly (and anytime, for that matter), DO NOT touch the surfaces of the telescope mirrors or the lenses of the finder scope or eyepieces with your fingers. The optical surfaces have delicate coatings on them that can easily be damaged if touched inappropriately. NEVER remove any lens assembly from its housing for any reason, or the product warranty and return policy will be voided.

1. Lay the altazimuth mount on its side. Attach the tripod legs, one at a time, to the base of the mount by sliding a tripod attachment screw through the top of a leg and

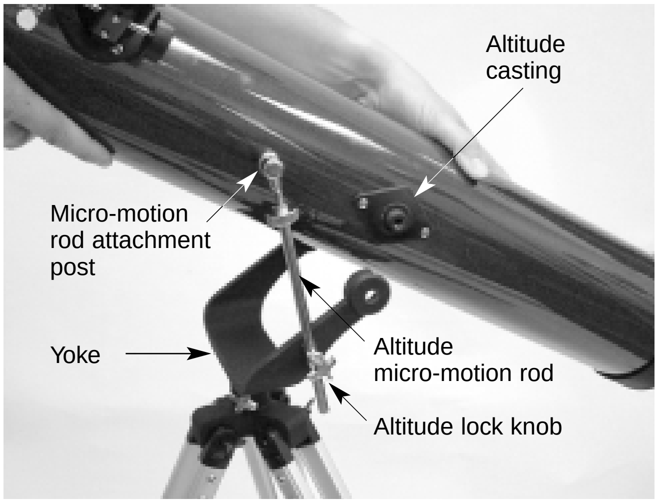

Figure 2. Installing the optical tube into the yoke of the altazimuth mount.

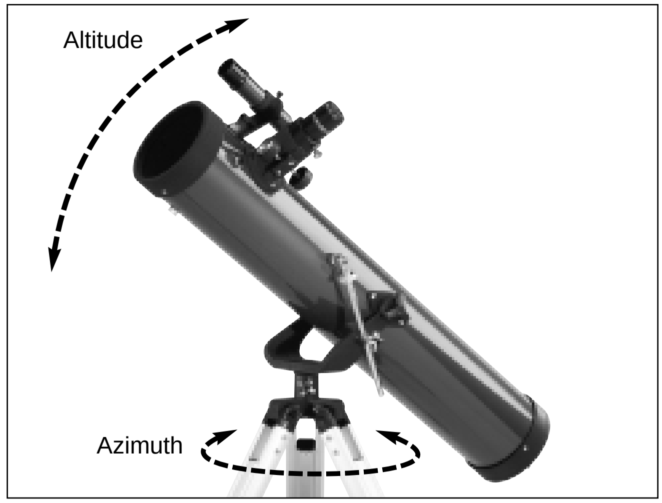

Figure 3. The SpaceProbe 3 has two axes of motion: Altitude and Azimuth.

through the holes in the base of the mount. The washers should be on the outside of the tripod legs. Secure the wing nuts finger-tight.

2. Install and tighten the leg lock knobs on the bottom braces of the tripod legs. For now, keep the legs at their shortest (fully retracted) length; you can extend them to a more desirable length later, after the tripod is completely assembled.
3. Stand the tripod and mount upright and spread the tripod legs apart as far as they will go, until the bracket is taut. Connect the accessory tray to the accessory tray bracket with the three wing screws already installed in the tray. Do this by pushing the wing screws up through the holes in the accessory tray bracket and threading them into the holes in the accessory tray.
4. Tighten the screws at the tops of the tripod legs, so the legs are securely fastened to the mount. Use the Phillips head screwdriver and your fingers to do this.
5. Attach the altitude micro-motion rod to the optical tube assembly by first removing the flat head screw from the micro-motion rod attachment post on the side of the optical tube. Slide the screw through the hole at the end of the micro-motion rod and rethread the screw into the attachment post. Make sure the screw is securely tightened.
6. To install the optical tube in the yoke of the altazimuth mount, slide the altitude micro-motion rod into its receptacle on the side of the yoke first. Make sure the altitude lock knob is adequetely loosened. Then, with the rod in place in the receptacle, place the optical tube assembly into the yoke so that the metal altitude castings on the side of the optical tube slide into the grooves (Figure 2.) To secure the optical tube to the mount, slide the yoke knobs through the holes in the of the mount and thread them into the altitude castings on the optical tube. Tighten the altitude lock knob.
7. Remove the two metal thumbnuts from the optical tube. Place the bracket of the EZ Finder II on the tube so that the holes in the bracket slide over the two threaded posts. The EZ Finder should be oriented so that it appears as in Figure 1. Thread the thumbnuts back onto the posts to secure the EZ Finder II in place.
8. Insert the 25mm Explorer II eyepiece into the focuser drawtube and secure it in place with the thumbscrew.

Your telescope is now fully assembled and should appear as it does in Figure 1. Keep the dust cover on until you are ready to observe.

4. Getting Started

Altitude and Azimuth

The SpaceProbe 3 Altaz permits motion along two axis: altitude (up/down) and azimuth (left/right) (see Figure 3). This is very convenient, since up/down and left/right are the most “natural” ways that people aim. As a result, pointing the telescope is easy.

To move the telescope in the azimuth direction, loosen the azimuth lock knob, take hold of the telescope by the end of the optical tube, and gently rotate the telescope to the desired position. Then re-tighten the azimuth lock knob. To move the telescope in the altitude direction, loosen the altitude lock knob, take hold of the end of the optical tube and move the tube up or down to the desired position. Then re-tighten the altitude lock knob. If the telescope moves too freely in the in the altitude direction, then tighten the yoke knobs.

Note about the Altitude Micro-Motion Rod and Thumbwheel: Since making fine-adjustments to the altitude of the telescope can be difficult, the SpaceProbe 3 Altaz comes with an altitude micro-motion rod and thumbwheel. By turning the thumbwheel, the telescope will move a very small amount either up or down, depending on which direction you turn the thumbwheel. You do not loosen the altitude lock knob to make adjustments with the thumbwheel. There is a limit to how far the thumbwheel can turn in either direction, so if you need to

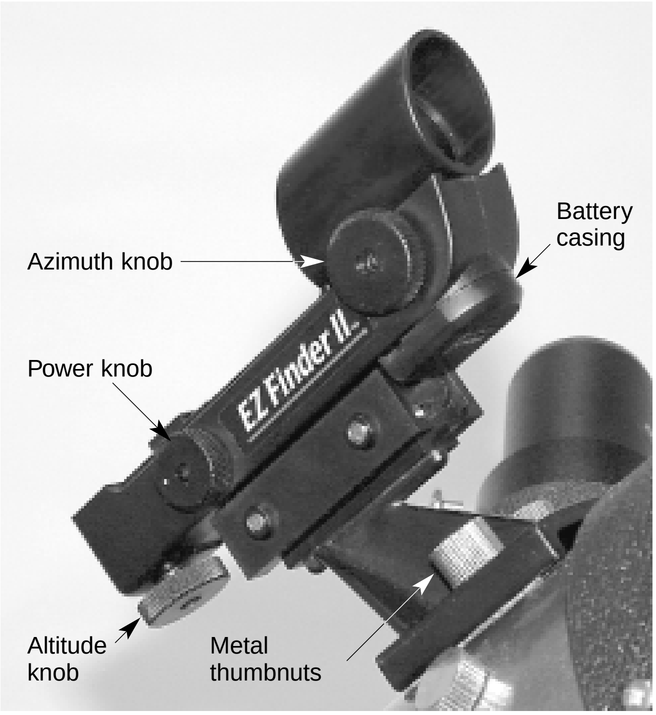

Figure 4.

make any large altitude adjustments to the telescope it is best to simply loosen the altitude lock knob and move the scope by hand.

Focusing the Telescope

Insert the 25mm Explorer II eyepiece into the focuser and secure it with the thumbscrew. Move the telescope so the front (open) end is pointing in the general direction of an object at least 1/4-mile away. Now with your fingers, slowly rotate one of the focusing knobs until the object comes into sharp focus. Go a little bit beyond sharp focus until the image starts to blur again, then reverse the rotation of the knob, just to make sure you've hit the exact focus point.

Do You Wear Eyeglasses?

If you wear eyeglasses, you may be able to keep them on while you observe. In order to do this, your eyepiece must have enough "eye relief" to allow you to see the entire field of view with glasses on. You can try this by looking through the eyepiece first with your glasses on and then with them off, and see if the glasses restrict the view to only a portion of the full field. If the glasses do restrict the field of view, you may be able to observe with your glasses off by just refocusing the telescope the needed amount.

If your eyes are astigmatic, images will probably appear the best with glasses on. This is because a telescope's focuser can accommodate for nearsightedness or farsightedness, but not astigmatism. If you have to wear your glasses while observing and cannot see the entire field of view, you may want to purchase additional eyepieces that have longer eye relief.

Operating the EZ Finder II reflex finder

The EZ Finder II reflex finder (Figure 4) works by projecting a tiny red dot onto a lens mounted in the front of the unit. When you look through the EZ Finder II, the red dot will appear to float in space, helping you locate even the faintest of deep space objects. The red dot is produced by a light-emitting diode (LED), not a laser beam, near the rear of the sight. A replaceable 3-volt lithium battery provides the power for the diode.

To use the EZ Finder II, turn the power knob clockwise until you hear a "click" indicating that power has been turned on. With your eye positioned at a comfortable distance, look through the back of the reflex sight with both eyes open to see the red dot. The intensity of the dot can be adjusted by turning the power knob. For best results when stargazing, use the dimmest possible setting that allows you to see the dot without difficulty. Typically, a dim setting is used under dark skies and a bright setting is used under light-polluted skies or in daylight.

At the end of your observing session, be sure to turn the power knob counterclockwise until it clicks off. When the two white dots on the EZ Finder II's rail and power knob are lined up, the EZ Finder II is turned off.

Aligning the EZ Finder II

When the EZ Finder II is properly aligned with the telescope, an object that is centered on the EZ Finder II's red dot should also appear in the center of the field of view of the telescope's eyepiece. Alignment of the EZ Finder II is easiest during daylight, before observing at night. Aim the telescope at a distant object at least 1/4 mile away, such as a telephone pole or chimney and center it in the telescope's eyepiece. Now, turn the EZ Finder II on and look through it. The object will appear in the field of view near the red dot.

Note: The image in the eyepiece of the telescope will be upside-down (rotated 180°). This is normal for Newtonian reflector telescopes.

Without moving the telescope, use the EZ Finder II's azimuth (left/right) and altitude (up/down) adjustment knobs to position the red dot on the object in the eyepiece.

When the red dot is centered on the distant object, check to make sure that the object is still centered in the telescope's field of view. If not, recenter it and adjust the EZ Finder II's alignment again. When the object is centered in the eyepiece and on the red dot, the EZ Finder II is properly aligned with the telescope.

Once aligned, EZ Finder II will usually hold its alignment even after being removed from its bracket. If the EZ Finder II's bracket is removed entirely from the optical tube then realignment will be needed.

Replacing the EZ Finder II Battery

Replacement 3-volt lithium batteries for the EZ Finder II are available from many retail outlets. Remove the old battery by inserting a small flat-head screwdriver into the slot on the battery casing (Figure 4) and gently prying open the case. Then carefully pull back on the retaining clip and remove the old battery. Do not overbend the retaining clip. Slide the new battery under the battery lead with the positive (+) side facing down and replace the battery casing.

5. Using Your Telescope—Astronomical Observing

Choosing an Observing Site

When selecting a location for observing, get as far away as possible from direct artificial light such as street lights, porch lights, and automobile headlights. The glare from these lights will greatly impair your dark-adapted night vision. Set up on a grass or dirt surface, not asphalt, because asphalt radiates more heat. Heat disturbs the surrounding air and degrades the images seen through the telescope. Avoid viewing over rooftops and chimneys, as they often have warm air currents rising from them. Similarly, avoid observing from indoors through an open (or closed) window, because the temperature difference between the indoor and outdoor air will cause image blurring and distortion.

If at all possible, escape the light-polluted city sky and head for darker country skies. You'll be amazed at how many more stars and deep-sky objects are visible in a dark sky!

"Seeing" and Transparency

Atmospheric conditions vary significantly from night to night. "Seeing" refers to the steadiness of the Earth's atmosphere at a given time. In conditions of poor seeing, atmospheric turbulence causes objects viewed through the telescope to "boil". If, when you look up at the sky with just your eyes, the stars are twinkling noticeably, the seeing is bad and you will be limited to viewing with low powers (bad seeing affects images at high powers more severely). Planetary observing may also be poor.

In conditions of good seeing, star twinkling is minimal and images appear steady in the eyepiece. Seeing is best overhead, worst at the horizon. Also, seeing generally gets better after midnight, when much of the heat absorbed by the Earth during the day has radiated off into space.

Especially important for observing faint objects is good "transparency"—air free of moisture, smoke, and dust. All tend to scatter light, which reduces an object's brightness. One good way to tell if conditions are good is by how many stars you can see with your naked eye. If you cannot see stars of magnitude 3.5 or dimmer then conditions are poor. Magnitude is a measure of how bright a star is, the brighter a star is, the lower its magnitude will be. A good star to remember for this is Megrez (mag. 3.4), which is the star in the "Big Dipper" connecting the handle to the "dipper". If you cannot see Megrez, then you have fog, haze, clouds, smog, or other conditions that are hindering your viewing. (See Figure 5)

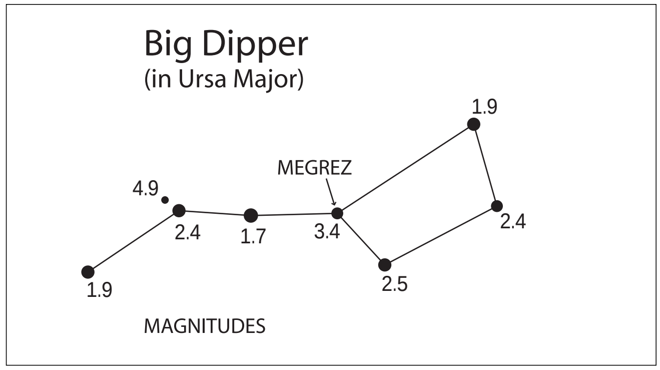

Figure 5. Megrez connects the Big Dipper's handle to it's "pan". It is a good guide to how conditions are. If you can not see Megrez (a 3.4 mag star) then conditions are poor.

Tracking Celestial Objects

The Earth is constantly rotating about its polar axis, completing one full rotation every 24 hours; this is what defines a "day". We do not feel the Earth rotating, but we can still tell that it is at night by seeing the apparent movement of stars from east to west.

When you observe any astronomical object, you are watching a moving target. This means the telescope's position must be continuously updated over time to keep an object in the field of view. When viewing the with the SpaceProbe 3 Altaz, you will need to give the tube a light tug or push in azimuth as well as an occasional turn of the altitude micro-motion thumbwheel to keep the object in the field of view. (Make certain the azimuth lock knob is slightly loosened before moving the scope in the azimuth position.) Objects will appear to move faster at higher magnifications, when the field of view is narrower. Remember that objects are inverted in the telescope, so when you move the telescope in one direction, the object in the eyepiece will move in the opposite direction than you would normally expect. This takes some getting used to, but becomes second nature after a few nights out with the telescope.

Cooling the Telescope

All optical instruments need time to reach "thermal equilibrium." The bigger the instrument and the larger the temperature change, the more time is needed. Allow at least 30 minutes for your telescope to cool to the temperature outdoors.

Let Your Eyes Dark-Adapt

Don't expect to go from a lighted house into the darkness of the outdoors at night and immediately see faint nebulas, galaxies, and star clusters—or even very many stars, for that matter. Your eyes take about 30 minutes to reach perhaps 80% of their full dark-adapted sensitivity. As your eyes become dark-adapted, more stars will glimmer into view and you'll be able to see fainter details in objects you view in your telescope.

To see what you're doing in the darkness, use a red-filtered flashlight rather than a white light. Red light does not spoil your eyes' dark adaptation like white light does. A flashlight with a red LED light is ideal, or you can cover the front of a regular incandescent flashlight with red cellophane or paper. Beware, too, that nearby porch and streetlights and car headlights will ruin your night vision.

Eyepiece Selection

By using eyepieces of varying focal lengths, it is possible to attain many magnifications with your telescope. The SpaceProbe 3 Altaz comes with two Explorer II eyepieces, a 25mm and a 10mm. These give magnifications of 28x and 70x respectively. Other eyepieces can be used to achieve higher or lower powers. It is quite common for an observer to own five or more eyepieces to access a wide range of magnifications. This allows the observer to choose the best eyepiece to use depending on the object being viewed.

To calculate the magnification, or power, of a telescope and eyepiece combination, simply divide the focal length of the telescope by the focal length of the eyepiece:

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

For example, the SpaceProbe 3 Altaz, which has a focal length of 700mm, used in combination with the 25mm eyepiece, yields a magnification of:

$$\frac{\textbf{700mm}}{\textbf{25mm}} = \textbf{28x}$$

Every telescope has a useful limit of power of about 2x per mm of aperture (about 152x for the SpaceProbe 3 Altaz.) Claims of higher power by some telescope manufacturers are a misleading advertising gimmick and should be dismissed. Keep in mind that at higher powers, an image will always be dimmer and less sharp (this is a fundamental law of optics.) The steadiness of the air (the "seeing") will also limit how much magnification an image can tolerate.

Whatever you choose to view, always start by inserting your lowest-power (longest focal length) eyepiece to locate and center the object. Low magnification yields a wide field of view, which shows a larger area of sky in the eyepiece. This makes acquiring and centering an object much easier. If you try to find and center objects with high power (narrow field of view), its like trying to find a needle in a haystack!

Once you've centered the object in the eyepiece, you can switch to higher magnification (shorter focal length eyepiece), if you wish. This is especially recommended for small and bright objects, like planets and double stars. The Moon also takes higher magnifications well.

The best rule of thumb with eyepiece selection is to start with a low power, wide-field eyepiece, and then work your way up in magnification. If the object looks better, try an even higher magnification. If the object looks worse, then back off the magnification a little by using a lower-power eyepiece.

What to Expect

So what will you see with your telescope? You should be able to see bands on Jupiter, the rings of Saturn, craters on the Moon, the waxing and waning of Venus, and many bright deep-sky objects. Do not expect to see color as you do in NASA photos, since those are taken with long-exposure cameras and have "false color" added. Our eyes are not sensitive enough to see color in deep-sky objects except in a few of the brightest ones.

Remember that you are seeing these objects using your own telescope with your own eyes! The object you see in your eyepiece is in real-time, and not some conveniently provided image from an expensive space probe. Each session with your telescope will be a learning experience. Each time you work with your telescope it will get easier to use, and stellar objects will become easier to find. Take it from us, there is big difference between looking at a well-made full-color NASA image of a deep-sky object in a lit room during the daytime, and seeing that same object in your telescope at night. One can merely be a pretty image someone gave to you. The other is an experience you will never forget!

Objects to Observe

Now that you are all set up and ready to go, one critical decision must be made: what to look at?

A. The Moon

With its rocky surface, the Moon is one of the easiest and most interesting targets to view with your telescope. Lunar craters, marias, and even mountain ranges can all be clearly seen from a distance of 238,000 miles away! With its ever-changing phases, you'll get a new view of the Moon every night. The best time to observe our one and only natural satellite is during a partial phase, that is, when the Moon is NOT full. During partial phases, shadows are cast on the surface, which reveal more detail, especially right along the border between the dark and light portions of the disk (called the "terminator"). A full Moon is too bright and devoid of surface shadows to yield a pleasing view. Make sure to observe the Moon when it is well above the horizon to get the sharpest images.

Use an optional Moon filter to dim the Moon when it is very bright. It simply threads onto the bottom of the eyepieces (you must first remove the eyepiece from the focuser to attach a filter). You'll find that the Moon filter improves viewing comfort, and also helps to bring out subtle features on the lunar surface.

B. The Planets

The planets don't stay put like the stars, so to find them you should refer to Sky Calendar at our website (telescope.com), or to charts published monthly in *Astronomy, Sky & Telescope,* or other astronomy magazines. Venus, Mars, Jupiter, and Saturn are the brightest objects in the sky after the Sun and the Moon. Your SpaceProbe 3 Altaz is capable of showing you these planets in some detail. Other planets may be visible but will likely appear star-like. Because planets are quite small in apparent size, optional higher-power eyepieces are recommended and often needed for detailed observations. Not all the planets are generally visible at any one time.

JUPITER: The largest planet, Jupiter, is a great subject for observation. You can see the disk of the giant planet and watch the ever-changing positions of its four largest moons—Io, Callisto, Europa, and Ganymede.

SATURN: The ringed planet is a breathtaking sight when it is well positioned. The tilt angle of the rings varies over a period of many years; sometimes they are seen edge-on, while at other times they are broadside and look like giant “ears” on each side of Saturn’s disk. A steady atmosphere (good seeing) is necessary for a good view. You will probably see a bright “star” close by, which is Saturn’s brightest moon, Titan.

VENUS: At its brightest, Venus is the most luminous object in the sky, excluding the Sun and the Moon. It is so bright that sometimes it is visible to the naked eye during full daylight! Ironically, Venus appears as a thin crescent, not a full disk, when at its peak brightness. Because it is so close to the Sun, it never wanders too far from the morning or evening horizon. No surface markings can be seen on Venus, which is always shrouded in dense clouds.

MARS: The Red Planet makes its closest approach to Earth every two years. During close approaches you’ll see a red disk, and may be able to see the polar ice cap.

C. The Stars

Stars will appear like twinkling points of light. Even powerful telescopes cannot magnify stars to appear as more than a point of light. You can, however, enjoy the different colors of the stars and locate many pretty double and multiple stars. The famous “Double-Double” in the constellation Lyra and the gorgeous two-color double star Albireo in Cygnus are favorites. Defocusing a star slightly can help bring out its color.

D. Deep-Sky Objects

Under dark skies, you can observe a wealth of fascinating deep-sky objects, including gaseous nebulas, open and globular star clusters, and a variety of different types of galaxies. Most deep-sky objects are very faint, so it is important that you find an observing site well away from light pollution. Take plenty of time to let your eyes adjust to the darkness. Do not expect these subjects to appear like the photographs you see in books and magazines; most will look like dim gray smudges. Our eyes are not sensitive enough to see color in deep-sky objects except in a few of the brightest ones. But as you become more experienced and your observing skills get sharper, you will be able to ferret out more and more subtle details and structure.

To find deep sky objects in the sky, it is best to consult a star chart or Planisphere. These guides will help you locate the brightest and best deep-sky objects for viewing with your SpaceProbe 3 Altaz.

6. Care and Maintenance

If you give your telescope reasonable care, it will last a lifetime. Store it in a clean, dry, dust free place, safe from rapid changes in temperature and humidity. Do not store the telescope outdoors, although storage in a garage or shed is OK. Small components like eyepieces and other accessories should be kept in a protective box or storage case. Keep the caps on the front of the telescope and on the focuser drawtube when not in use.

Your SpaceProbe 3 Altaz telescope requires very little mechanical maintenance. The optical tube is steel and has a smooth painted finish that is fairly scratch resistant. If a scratch does appear, it will not harm the telescope. Refer to Appendix B at the end of this manual for details of how to clean your telescope’s optics.

7. Specifications

Optical tube: Steel

Primary mirror diameter: 76mm

Primary mirror coating: Aluminum with silicon dioxide (SiO_2) overcoat

Secondary mirror minor axis: 19.9mm

Focal length: 700mm

Focal ratio: f/9.2

Focuser: Rack and pinion, accepts 1.25" eyepieces

Eyepieces: 25mm and 10mm Explorer II eyepieces, 1.25"

Finder: EZ Finder II reflex sight

Magnification: 28x (with 25mm) and 70x (with 10mm)

Tripod: Aluminum

Weight: 8.4 lbs.

Appendix A: Collimating—Aligning the Mirrors

Collimating is the process of adjusting the mirrors so they are perfectly aligned with one another. Your telescope’s optics were aligned at the factory, and should not need much adjustment unless the telescope is handled roughly. Accurate mirror alignment is important to ensure the peak performance of your telescope, so it should be checked regularly. Collimating is relatively easy to do and can be done in daylight.

To check collimation, remove the eyepiece and look down the focuser drawtube. You should see the secondary mirror centered in the drawtube, as well as the reflection of the primary mirror centered in the secondary mirror, and the reflection of the secondary mirror (and your eye) centered in the reflection of the primary mirror, as in Figure 6a. If anything is off-center, proceed with the following collimation procedure.

The Collimation Cap and Mirror Center Mark

Your SpaceProbe 3 comes with a collimation cap. This is a simple cap that fits on the focuser drawtube like a dust cap, but has a hole in the center and a silver bottom. This helps

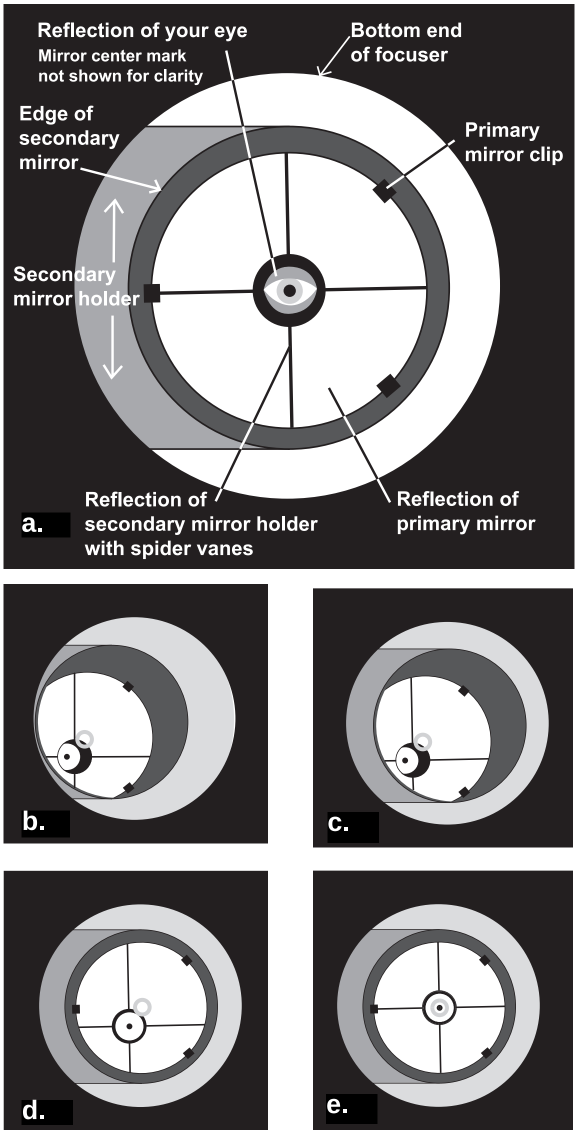

Figure 6. Collimating the optics. (a) When the mirrors are properly aligned, the view down the focuser drawtube should look like this. (b) With the collimation cap in place, if the optics are out of alignment, the view might look something like this. (c) Here, the secondary mirror is centered under the focuser, but it needs to be adjusted (tilted) so that the entire primary mirror is visible. (d) The secondary mirror is correctly aligned, but the primary mirror still needs adjustment. When the primary mirror is correctly aligned, the "dot" will be centered, as in (e).

center your eye so that collimation is easy to perform. Figures 6b through 6e assume you have the collimation cap in place.

In addition to providing the collimation cap, you'll notice a tiny ring (sticker) in the exact center of the primary mirror. This "center mark" allows you to achieve a very precise collimation of the primary mirror; you don't have to guess where the center of the mirror is. You simply adjust the mirror position (described below) until the reflection of the hole in the collimation cap is centered inside the ring. This center mark is

Figure 7. To center the secondary mirror under the focuser, hold the secondary in place with your fingers while adjusting the primary screw with a Phillips head screwdriver. Do not touch the mirror's surface.

also required for best results with other collimating devices, such as Orion's LaserMate Laser Collimator, obviating the need to remove the primary mirror and mark it yourself.

NOTE: The center ring sticker* need not ever be removed *from the primary mirror. Because it lies directly in the shadow of the secondary mirror, its presence in no way adversely affects the optical performance of the telescope or the image quality. That might seem counter-intuitive, but it's true!

Aligning the Secondary Mirror

With the collimation cap in place, look through the hole in the cap at the secondary (diagonal) mirror. Ignore the reflections for the time being. The secondary mirror itself should be centered in the focuser drawtube, in the direction parallel to the length of the telescope. If it isn't, as in Figure 6b, it must be adjusted. This adjustment will rarely, if ever, need to be done. It helps to adjust the secondary mirror in a brightly lit room with the telescope pointed toward a bright surface, such as white paper or wall. Placing a piece of white paper in the telescope tube opposite the focuser (i.e., on the other side of the secondary mirror) will also be helpful in collimating the secondary mirror. Use a Phillips head screwdriver to loosen the three small alignment screws in the center hub of the 3-vaned spider several turns. Now hold the mirror holder stationary (be careful not to touch the surface of the mirrors), while turning the larger center screw with a Phillips head screwdriver (see Figure 7). Turning the screw clockwise will move the secondary mirror toward the front opening of the optical tube, while turning the screw counter-clockwise will move the secondary mirror toward the primary mirror.

When the secondary mirror is centered in the focuser drawtube, rotate the secondary mirror holder until the reflection of

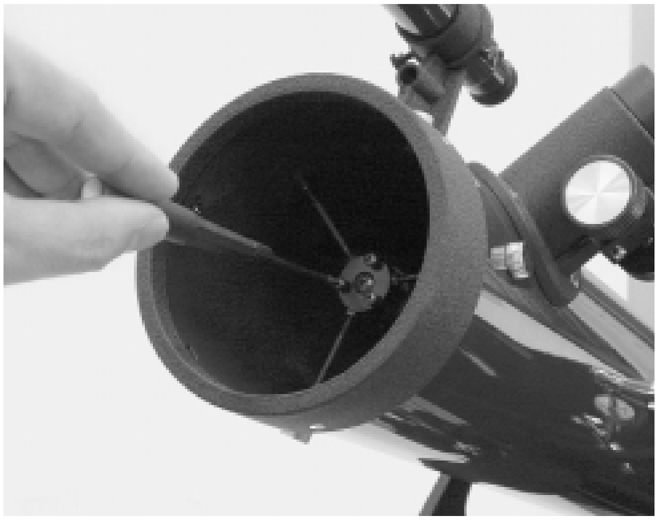

Figure 8. Adjust the tilt of the secondary mirror by loosening or tightening the three alignment screws with a small Phillips head screwdriver.

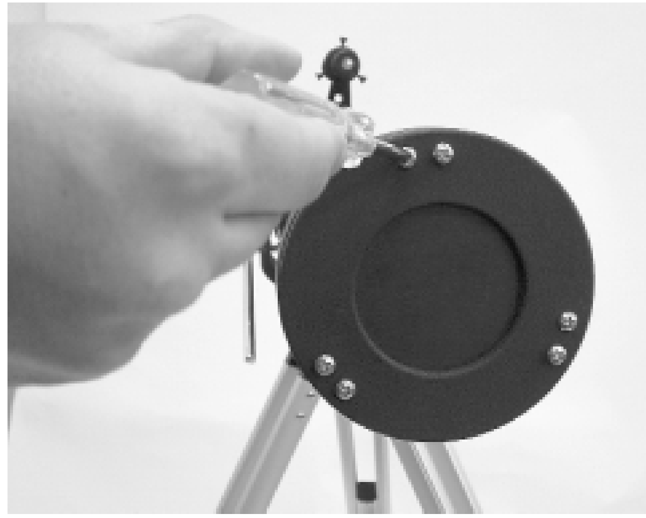

Figure 9. Loosen one screw on the back of the optical tube one full turn and tighten the other screw "in the set" until tight to adjust the primary mirror.

the primary mirror is as centered in the secondary mirror as possible. It may not be perfectly centered, but that is OK. Now tighten the three small alignment screws equally to secure the secondary mirror in that position.

If the entire primary mirror reflection is not visible in the secondary mirror, as in Figure 6c, you will need to adjust the tilt of the secondary mirror. This is done by alternately loosening one of the three alignment screws while tightening the other two, as depicted in Figure 8. The goal is to center the primary mirror reflection in the secondary mirror, as in Figure 6d. Don't worry that the reflection of the secondary mirror (the smallest circle, with the collimation cap "dot" in the center) is off-center. You will fix that in the next step.

Adjusting the Primary Mirror

The final adjustment is made to the primary mirror. It will need adjustment if, as in Figure 6d, the secondary mirror is centered under the focuser and the reflection of the primary mirror is centered in the secondary mirror, but the small reflection of the secondary mirror (with the "dot" of the collimation cap) is off-center.

The tilt of the primary mirror is adjusted using the three sets of two collimation screws on the back end of the optical tube. Adjusting the tilt of the mirror requires a "push-pull" technique involving adjustment of each set of collimation screws. Loosen the one of the screws one full turn, and then tighten the adjacent screw until it is tight as in Figure 9 (do not overtighten.) Look into the focuser and see if the secondary mirror reflection has moved closer to the center of the primary. You can tell this easily with the collimation cap and mirror center mark by simply watching to see if the "dot" of the collimation cap is moving closer or farther away from the ring on the center of the primary mirror. Repeat this process on the other two sets of collimation screws, if necessary. It will take a little trial and error to get a feel for how to tilt the mirror in this way. When you have the dot centered as much as possible in the ring, your primary mirror is collimated. The view through the collimation cap should resemble Figure 6e. Make sure all the collimation screws are tight (but do not overtighten), to secure the mirror tilt.

A simple star test will tell you whether the optics are accurately collimated.

Star-Testing the Telescope

When it is dark, point the telescope at a bright star and accurately center it in the eyepiece's field of view. Slowly de-focus the image with the focusing knob. If the telescope is correctly collimated, the expanding disk should be a perfect circle (Figure 10). If the image is unsymmetrical, the scope is out of collimation. The dark shadow cast by the secondary mirror should appear in the very center of the out-of-focus circle, like the hole in a donut. If the "hole" appears off-center, the telescope is out of collimation.

If you try the star test and the bright star you have selected is not accurately centered in the eyepiece, the optics will always appear out of collimation, even though they may be perfectly aligned. It is critical to keep the star centered, so over time you will need to make slight corrections to the telescope's position in order to account for the sky's apparent motion.

Appendix B: Cleaning the Optics

Cleaning Lenses

Any quality optical lens cleaning tissue and optical lens cleaning fluid specifically designed for multi-coated optics can be used to clean the exposed lenses of your eyepieces or finderscope. Never use regular glass cleaner or cleaning fluid designed for eyeglasses

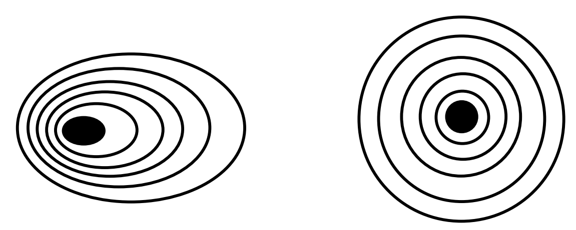

Figure 10. A star test will determine if a telescope's optics are properly collimated. An unfocused view of a bright star through the eyepiece should appear as illustrated on right if the optics are perfectly collimated. If the circle is unsymmetrical, as in the illustration on left, the telescope needs collimation.

Before cleaning with fluid and tissue, blow any loose particles off the lens with a blower bulb or compressed air. Then 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. On larger lenses, clean only a small area at a time, using a fresh lens tissue on each area. Never reuse tissues.

Cleaning Mirrors

You should not have to clean the telescope's mirror very often; normally once every year or so. Covering the telescope with the dust cap when it is not in use will help prevent dust from accumulating on the mirrors. Improper cleaning can scratch mirror coatings, so the fewer times you have to clean the mirrors, the better. Small specks of dust or flecks of paint have virtually no effect on the visual performance of the telescope

The large primary mirror and the elliptical secondary mirror of your telescope are front-surface aluminized and over coated with hard silicon dioxide, which prevents the aluminum from oxidizing. These coatings normally last through many years of use before requiring re-coating, which is easily done.

To clean the secondary mirror, it must be removed from the telescope. Do this by holding the secondary mirror holder stationary with your fingers (don't touch the mirror itself) while unthreading the Phillips head screw in the center hub of the 3-vaned spider. Completely unthread the screw from the holder, and the holder will come loose in your fingers. Be careful not to lose the spring on the Phillips head screw.

Handle the mirror and its holder carefully. You do not need to remove the secondary mirror from its holder for cleaning. Follow the same procedure described below for cleaning the primary mirror.

To clean the primary mirror, carefully remove the mirror cell from the telescope. To do this, you must loosen the three screws from the end of the optical tube that are flush with the end of the tube. Completely loosen all three of the flush screws (do not loosen the other three screws) until the mirror cell comes out of the telescope.

Now, remove the mirror from the mirror cell by removing the three mirror clips that secure the mirror in its cell. Use a Phillips head screwdriver to unthread the mirror clip anchor screws. Next, hold the mirror by its edge, and remove it from the mirror cell. Be careful not to touch the aluminized surface of the mirror with your fingers. Set the mirror on a clean, soft towel. Fill a clean sink, free of abrasive cleanser, with room-temperature water, a few drops of liquid dishwashing detergent, and if possible, a capful of rubbing alcohol. Submerge the mirror (aluminized face up) in the water and let it soak for several minutes (or hours if it is a very dirty mirror). Wipe the mirror underwater with clean cotton balls, using extremely light pressure and stroking in straight lines across the surface. Use one ball for each wipe across the mirror. Then rinse the mirror under a stream of lukewarm water. Any particles on the surface can be swabbed gently with a series of clean cotton balls, each used just one time. Dry the mirror in a stream of air (a "blower bulb" works great), or remove any stray drops of water with the corner of a paper towel. Water will run off a clean surface. Dry the bottom and the edges with a towel (not the mirror surface!). Cover the mirror surface with Kleenex, and leave the entire assembly in a warm area until it is completely dry before reassembling the telescope.

One-Year Limited Warranty

This Orion SpaceProbe 3 Altazimuth 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. If the product is not registered, proof of purchase (such as a copy of the original invoice) 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, P. O. Box 1815, Santa Cruz, CA 95061; (800) 676-1343.

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