INSTRUCTION MANUAL

Orion®
SpaceProbe™ 3 EQ

#9843 Equatorial Reflector Telescope

ORION®
TELESCOPES & BINOCULARS
Providing Exceptional Consumer Optical Products Since 1975

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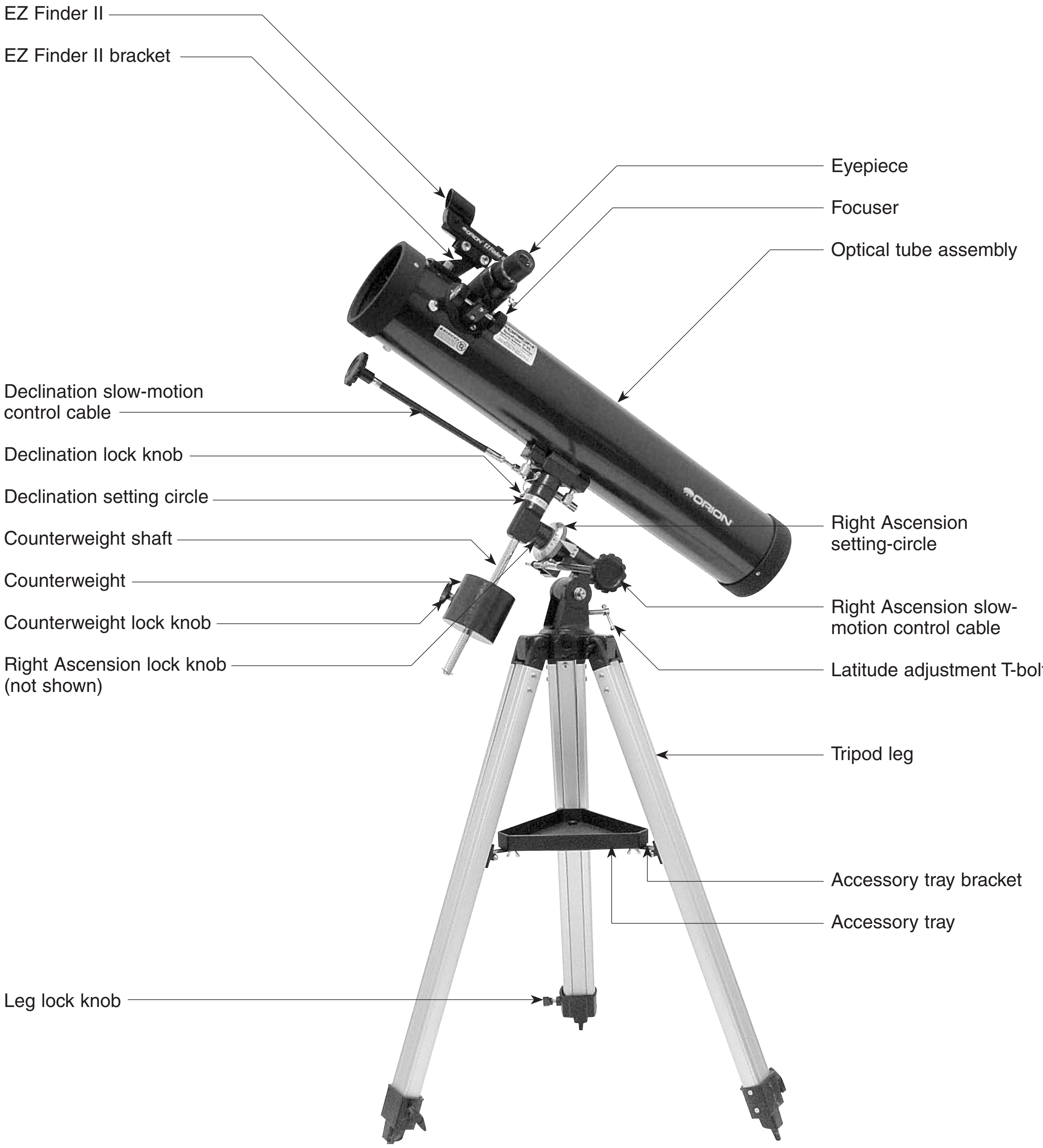

Figure 1. The SpaceProbe 3 EQ.

Welcome to the exciting world of amateur astronomy! Your SpaceProbe 3 EQ is a high-quality optical instrument designed for nighttime stargazing. With its precision optics and equatorial 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 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 Part 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	Equatorial mount
3	Tripod legs with accessory tray bracket attached
2	Slow-motion control cables
1	Counterweight
1	Counterweight shaft
1	EZ Finder II with bracket
1	Accessory tray with attachment wing screws
3	Tripod attachment screws with wing nuts and washers
3	Leg lock knobs
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 to assemble the telescope. 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 eyepiece 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 equatorial mount on its side. Attach the tripod legs, one at a time, to the base of the mount by sliding a tripod leg attachment screw through the top of a leg and through the holes in the base of the mount. The washers should

Figure 2. The equatorial mount of the SpaceProbe 3 EQ.

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. Next, 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. Orient the equatorial mount as it appears in Figure 2, at a latitude of about 40°, i.e., so the pointer next to the latitude scale is pointing to the hash mark at "40." To do this, loosen the latitude lock t-bolt, and turn the latitude adjustment t-bolt until the pointer and the "40" line up. Then retighten the latitude lock t-bolt. The declination (Dec.) and right ascension (R.A.) axes may need re-positioning (rotation) as well. Be sure to loosen the R.A. and Dec. lock knobs before doing this. Retighten the R.A. and Dec. lock knobs once the equatorial mount is properly oriented.
6. Thread the counterweight shaft into the equatorial mount at the base of the declination axis until tight.
7. Remove the screw and washer on the bottom of the counterweight shaft and slide the counterweight onto the shaft. Make sure the counterweight lock knob is adequately loosened to allow the counterweight shaft to pass through the hole. Position the counterweight about halfway up the shaft and tighten the lock knob. Replace the screw and washer on the end of the shaft.
8. Remove the two wingnuts from the optical tube assembly. Place the optical tube assembly on top of the equatorial mount and secure it with the wing nuts. Refer to Figure 1 for orientation of the tube.
9. Attach the two slow-motion cables to the R.A. and Dec. worm gear shafts of the equatorial mount by positioning the thumbscrew on the end of the cable over the indented slot on the worm gear shaft and then tightening the thumbscrew. We recommend that the shorter cable be used on the R.A. worm gear shaft and the longer cable on the Dec. worm gear shaft.
10. Remove the two metal thumbnuts located near the focuser at the front of 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 on the tube. 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.
11. 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.

4. Getting Started

Balancing the Telescope

To insure smooth movement of the telescope, it should be properly balanced. This is done by positioning the counterweight on its shaft at a point where it is balanced on the R.A. axis.

1. Keeping one hand on the optical tube, loosen the R.A. lock knob. Make sure the declination lock knob is locked. The telescope should now be able to rotate freely about the

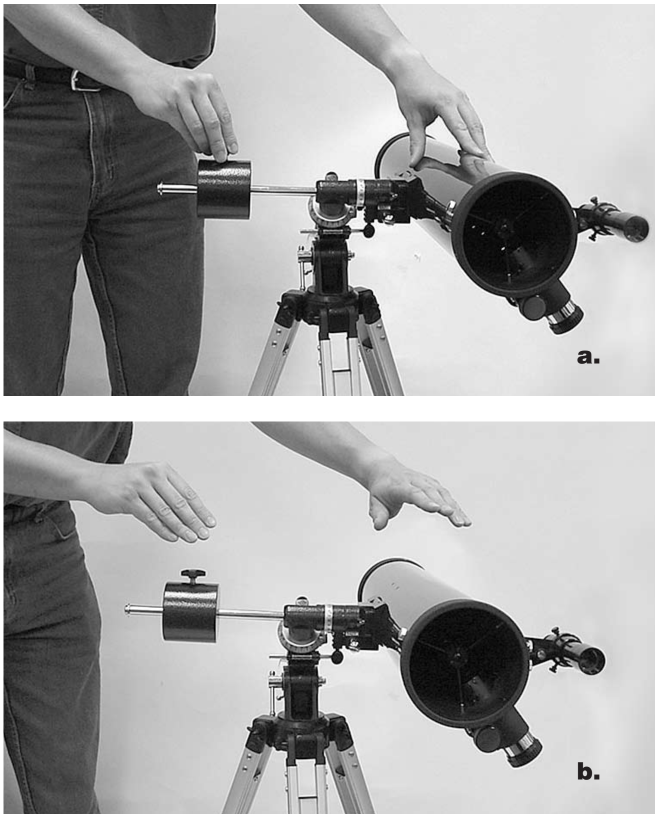

Figure 3. Proper operation of the equatorial mount requires balancing the telescope tube on the R.A. axis (a). With the R.A. lock knob released, slide the counterweight along the counterweight shaft until it just counterbalances the tube (b). When you let go with both hands, the tube should not drift up or down.

R.A. axis. Rotate it until the counterweight shaft is parallel to the ground (i.e., horizontal)

2. Now loosen the counterweight lock knob and slide the weight along the shaft until it exactly counterbalances the telescope (Figure 3a). That's the point at which the shaft remains horizontal even when you let go of the telescope with both hands (Figure 3b).
3. Retighten the counterweight lock knob. The telescope is now balanced in the right ascension axis. The telescope is already balanced in the declination axis.

Now when you loosen the lock knob on one or both axes and manually point the telescope, it should move without resistance and should not drift from where you point it.

Focusing the Telescope

Insert the 25mm Explorer II eyepiece into the focuser and secure 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.

Figure 4. The EZ Finder II.

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 eyes 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.

5. Setting up and Using the Equatorial Mount

When you look at the night sky, you no doubt have noticed that the stars appear to move slowly from east to west over time. That apparent motion is caused by the Earth's rotation (from west to east). An equatorial mount (Figure 2) is designed to compensate for that motion, allowing you to easily "track" the movement of astronomical objects, thereby keeping them from drifting out of the telescope's field of view while you're observing.

This is accomplished by slowly rotating the telescope on its right ascension (R.A.) axis, using only the R.A. slow-motion cable. But first the R.A. axis of the mount must be aligned with the Earth's rotational (polar) axis—a process called polar alignment.

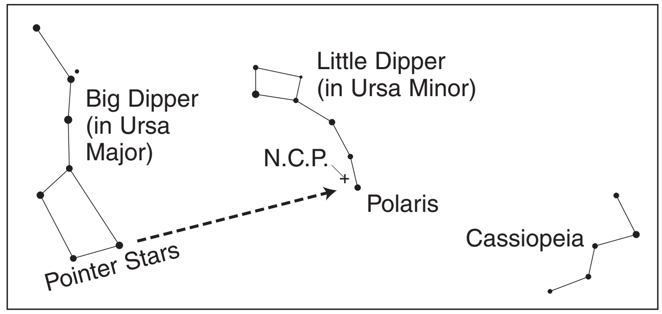

Figure 5. To find Polaris in the night sky, look north and find the Big Dipper. Extend an imaginary line from the two "Pointer Stars" in the bowl of the Big Dipper. Go about five times the distance between those stars and you'll reach Polaris, which lies within 1° of-the north celestial pole (NCP).

Polar Alignment

For Northern Hemisphere observers, approximate polar alignment is achieved by pointing the mount's R.A. axis at the North Star, or Polaris. It lies within 1° of the north celestial pole (NCP), which is an extension of the Earth's rotational axis out into space. Stars in the Northern Hemisphere appear to revolve around the NCP.

To find Polaris in the sky, look north and locate the pattern of the Big Dipper (Figure 5). The two stars at the end of the "bowl" of the Big Dipper point right to Polaris.

Observers in the Southern Hemisphere aren't so fortunate to have a bright star so near the south celestial pole (SCP). The star Sigma Octantis lies about 1° from the SCP, but it is barely visible with the naked eye (magnitude 5.5).

To polar-align the SpaceProbe 3 EQ:

1. Level the equatorial mount by adjusting the length of the three tripod legs.
2. Loosen the latitude lock t-bolt. Turn the latitude adjustment t-bolt and tilt the mount until the pointer on the latitude scale is set at the latitude of your observing site. If you don't know your latitude, consult a geographical atlas to find it. For example, if your latitude is 35° North, set the pointer to 35. Then retighten the latitude lock t-bolt. The latitude setting should not have to be adjusted again unless you move to a different viewing location some distance away.
3. Loosen the Dec. lock knob and rotate the telescope optical tube until it is parallel with the R.A. axis, as it is in Figure 1. The pointer on the Dec. setting circle should read 90°. Retighten the Dec. lock lever.
4. Loosen the azimuth lock knob at the base of the equatorial mount and rotate the mount so the telescope tube (and R.A. axis) points roughly at Polaris. If you cannot see Polaris directly from your observing site, consult a compass and rotate the mount so the telescope points North. Retighten the azimuth lock knob.

The equatorial mount is now polar aligned.

From this point on in your observing session, you should not make any further adjustments in the azimuth or the latitude of the mount, nor should you move the tripod. Doing so will undo the polar alignment. The telescope should be moved only about its R.A. and Dec. axes.

Use of the R.A. and Dec. Slow-Motion Control Cables

The R.A. and Dec. slow-motion control cables allow fine adjustment of the telescope's position to center objects within the field of view. Before you can use the cables, you must manually "slew" the mount to point the telescope in the vicinity of the desired target. Do this by loosening the R.A. and Dec. lock knobs and moving the telescope about the mount's R.A. and Dec. axes. Once the telescope is pointed somewhere close to the object to be viewed, retighten the mount's R.A. and Dec. lock knobs.

The object should now be visible somewhere in the telescope's finder scope. If it isn't, use the slow-motion controls to scan the surrounding area of sky. When the object is visible in the finder scope, use the slow-motion controls to center it. Now, look in the telescope's eyepiece. If the finder scope is properly aligned, the object should be visible somewhere in the field of view. Once the object is visible in the eyepiece, use the slow-motion controls to center it in the field of view.

The Dec. slow-motion control cable can move the telescope a maximum of 25°. This is because the Dec. slow-motion mechanism has a limited range of mechanical travel. (The R.A. slow-motion mechanism has no limit to its amount of travel.) If you can no longer rotate the Dec. control cable in a desired direction, you have reached the end of travel, and the slow-motion mechanism must be reset. This is done by first rotating the control cable several turns in the opposite direction from which it was originally being turned. Then, manually slew the telescope closer to the object you wish to observe (remember to first loosen the Dec. lock knob). You should now be able to use the Dec. slow-motion control cable again to fine adjust the telescope's position.

Tracking Celestial Objects

When you observe a celestial object through the telescope, you'll see it drift slowly across the field of view. To keep it in the field, if your equatorial mount is polar aligned, just turn the R.A. slow-motion control cable clockwise. The Dec. slow-motion control cable is not needed for tracking. Objects will appear to move faster at higher magnifications, because the field of view is narrower.

Optional Electronic Drives for Automatic-Tracking

An optional DC electronic drive can be mounted on the R.A. axis of the equatorial mount to provide hands-free tracking. Objects will then remain stationary in the field of view without any manual adjustment of the R.A. slow-motion control cable.

Understanding the Setting Circles

The setting circles on an equatorial mount enable you to locate celestial objects by their "celestial coordinates". Every object resides in a specific location on the "celestial sphere" That location is denoted by two numbers: its right ascension (R.A.) and declination (Dec.). In the same way, every location on Earth can be described by its longitude and latitude. R.A. is similar to longitude on Earth, and Dec. is similar to latitude. The R.A. and Dec. values for celestial objects can be found in any star atlas or star catalog.

The mount's R.A. setting circle is scaled in hours, from 1 through 24, with small marks in between representing 10-minute increments. The numbers closest to the R.A. axis gear apply to viewing in the Southern Hemisphere, while the numbers above them apply to viewing in the Northern Hemisphere.

The Dec. setting circle is scaled in degrees, with each mark representing 2.5° increments. Values of Dec. coordinates range from +90° to -90°. The 0° mark indicates the celestial equator. When the telescope is pointed north of the celestial equator, values of the Dec. setting circle are positive, while when the telescope is pointed south of the celestial equator, values of the Dec. setting circle are negative.

So, the coordinates for the Orion Nebula listed in a star atlas will look like this:

R.A. 5h 35.4m Dec. –5° 27'

That's 5 hours and 35.4 minutes in right ascension, and -5 degrees and 27 arc-minutes in declination (there are 60 arc-minutes in 1 degree of declination).

Before you can use the setting circles to locate objects, the mount must be correctly polar aligned, and the R.A. setting circle must be calibrated. The Dec. setting circle has been permanently calibrated at the factory, and should read 90° whenever the telescope optical tube is parallel with the R.A. axis.

Calibrating the Right Ascension Setting Circle

Identify a bright star in the sky near the celestial equator (Dec.-=-0°) and look up its coordinates in a star atlas.

1. Loosen the R.A. and Dec. lock knobs on the equatorial mount, so the telescope optical tube can move freely.
2. Point the telescope at the bright star whose coordinates you know. Lock the R.A. and Dec. lock knobs. Center the star in the telescope's field of view with the slow-motion control cables.
3. Rotate the setting circle until the metal arrow indicates the R.A. coordinate listed in the star atlas for the object.

Finding Objects With the Setting Circles

Now that both setting circles are calibrated, look up in a star atlas the coordinates of an object you wish to view.

Loosen the Dec. lock knob and rotate the telescope until the Dec. value from the star atlas matches the reading on the Dec. setting circle. Remember that values of the Dec. setting circle are positive when the telescope is pointing north of the celestial equator (Dec. = 0°), and negative when the telescope is pointing south of the celestial equator. Retighten the lock knob.

Loosen the R.A. lock knob and rotate the telescope until the R.A. value from the star atlas matches the reading on the R.A.

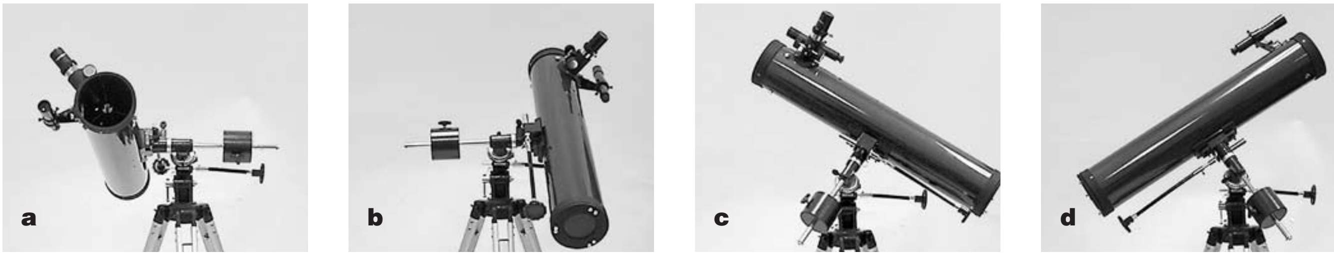

Figure 6. This illustration show the telescope pointed in the the four cardinal directions (a) north, (b) south, (c) east, (d) west. Note that the tripod and mount have not been moved; only the telescope tube has been moved on the R.A. and Dec. axes.

setting circle. Remember to use the upper set of numbers on the R.A. setting circle. Retighten the lock knob.

Most setting circles are not accurate enough to put an object dead-center in the telescope's eyepiece, but they should place the object somewhere within the field of view of the finder scope, assuming the equatorial mount is accurately polar aligned. Use the slow-motion controls to center the object in the finder scope, and it should appear in the telescope's field of view.

The R.A. setting circle must be re-calibrated every time you wish to locate a new object. Do so by calibrating the setting circle for the centered object before moving on to the next one.

Confused About Pointing the Telescope?

Beginners occasionally experience some confusion about how to point the telescope overhead or in other directions. In Figure 1 the telescope is pointed north, as it would be during polar alignment. The counterweight shaft is oriented downward. But it will not look like that when the telescope is pointed in other directions. Let's say you want to view an object that is directly overhead, at the zenith. How do you do it?

One thing you DO NOT do is make any adjustment to the latitude adjustment t-bolt. That will nullify the mount's polar alignment. Remember, once the mount is polar aligned, the telescope should be moved only on the R.A. and Dec. axes. To point the scope overhead, first loosen the R.A. lock knob and rotate the telescope on the R.A. axis until the counterweight shaft is horizontal (parallel to the ground). Then loosen the Dec. lock knob and rotate the telescope until it is pointing straight overhead. The counterweight shaft is still horizontal. Then retighten both lock knobs.

Similarly, to point the telescope directly south, the counterweight shaft should again be horizontal. Then you simply rotate the scope on the Dec. axis until it points in the south direction.

What if you need to aim the telescope directly north, but at an object that is nearer to the horizon than Polaris? You can't do it with the counterweight down as pictured in Figure 1. Again, you have to rotate the scope in R.A. so the counterweight shaft is positioned horizontally. Then rotate the scope in Dec. so it points to where you want it near the horizon.

To point the telescope to the east or west, or in other directions, you rotate the telescope on its R.A. and Dec. axes. Depending on the altitude of the object you want to observe, the counterweight shaft will be oriented somewhere between vertical and horizontal.

Figure 6 illustrates how the telescope will look pointed at the four cardinal directions—north, south, east, and west

The key things to remember when pointing the telescope is that a) you only move it in R.A. and Dec., not in azimuth or latitude (altitude), and b) the counterweight and shaft will not always appear as it does in Figure 1. In fact, it almost never will!

6. Using Your Telescope

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.

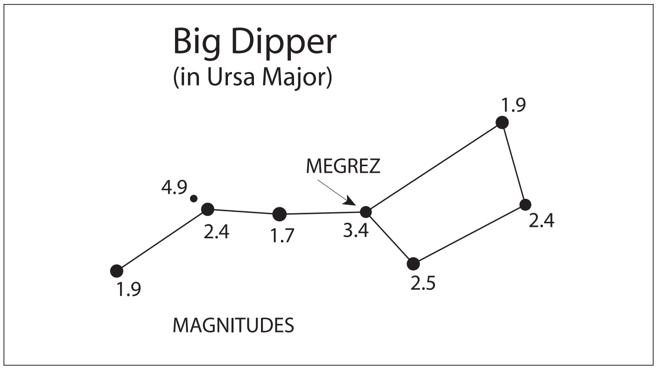

Figure 7. Megrez connects the Big Dipper's handle to it's "pan". It is a good guide to how conditions are. If you can not see Megrez (a 3.4 mag star) then conditions are poor.

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. Transparency is judged by the magnitude of the faintest stars you can see with the unaided eye (6th magnitude or fainter is desirable).

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 7)

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 the SpaceProbe 3 EQ. The SpaceProbe 3 EQ 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 EQ, which has a focal length of 700mm, used in combination with the 25mm eyepiece, yields a power of:

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

Every telescope has a useful limit of power of about 2x per mm of aperture (about 152x for the SpaceProbe 3 EQ). 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), it's 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 any 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 EQ 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 EQ.

7. 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 EQ 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 the appendix B at the end of this manual for details of how to clean your telescope's optics.

8. 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”

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

Mount: German Equatorial, EQ-1

Tripod: Aluminum

Weight: 16.6 lbs.

Motor drive: Optional

Appendix A: Collimation—Aligning the Mirrors

Collimation 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. Collimation 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 8a. 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 center your eye so that collimation is easy to perform. Figures 8b through 8e 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 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 counterintuitive, 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 8b, 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 small 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 center screw with a larger Phillips head screwdriver (see Figure 9). 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 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 8c, 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 10. The goal is to center the primary mirror reflection in the secondary mirror, as in Figure 8d. 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.

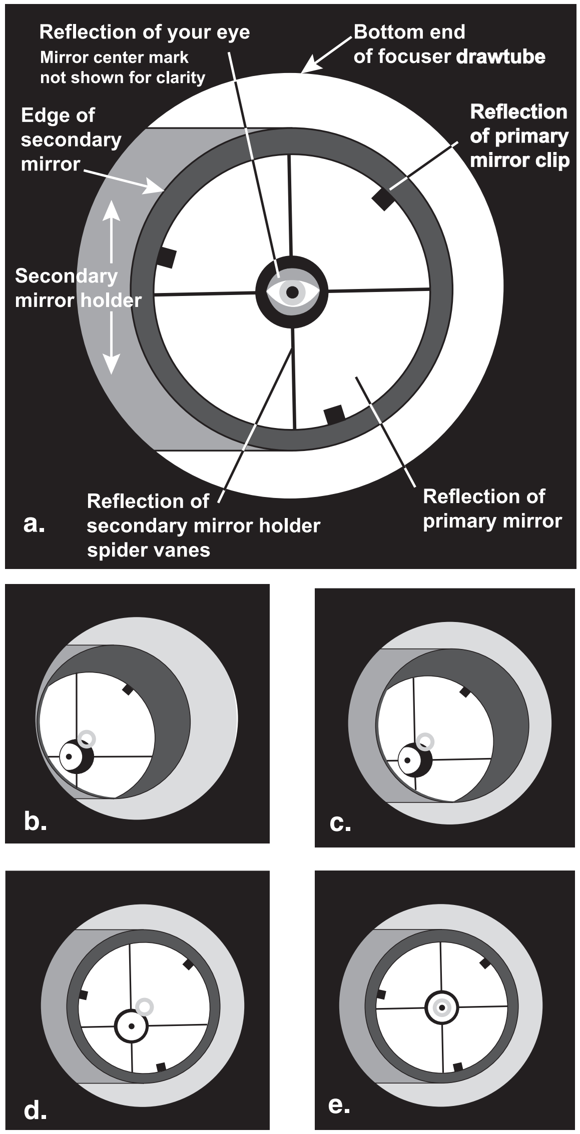

Figure 8. Collimating the optics. (a) When the mirrors are properly aligned, the view down the focuser drawtube should look like this. (b) With the collimation cap in place, if the optics are out of alignment, the view might look something like this. (c) Here, the secondary mirror is centered under the 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).

Adjusting the Primary Mirror

The final adjustment is made to the primary mirror. It will need adjustment if, as in Figure 8d, 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 flush screw one full turn, and then tighten the adjacent raised screw until it is tight as in Figure 11 (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 8e. 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 12). 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

Figure 9. 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.

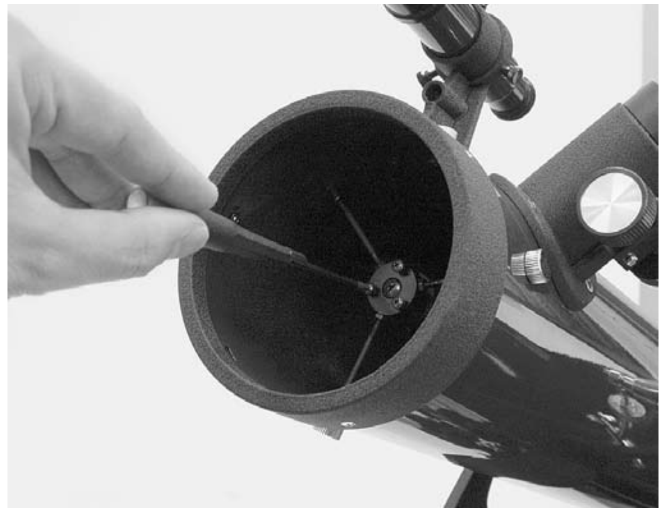

Figure 10. Adjust the tilt of the secondary mirror by loosening or tightening the three alignment screws with a small Phillips head screwdriver.

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

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.

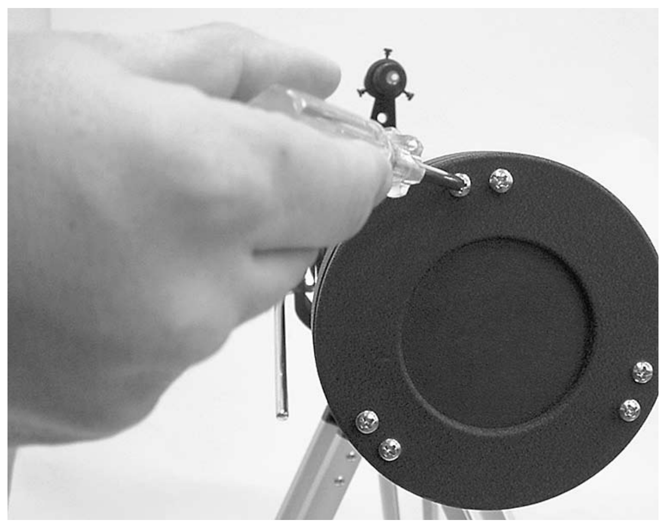

Figure 11. Loosen one screw on the back of the optical tube one full turn and tighten the other screw "in the set" until tight to adjust the primary mirror.

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 cap 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.

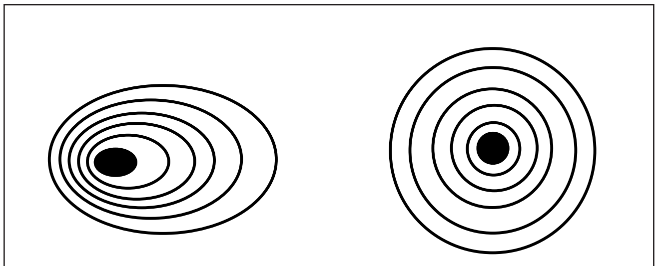

Figure 12. A star test will determine if a telescope's optics are properly collimated. An unfocused view of a bright star through the eyepiece should appear as illustrated on right if the optics are perfectly collimated. If the circle is unsymmetrical, as in the illustration on left, the telescope needs collimation.

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 EQ 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, 89 Hangar Way, Watsonville, CA 95076; (800)-676-1343.

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