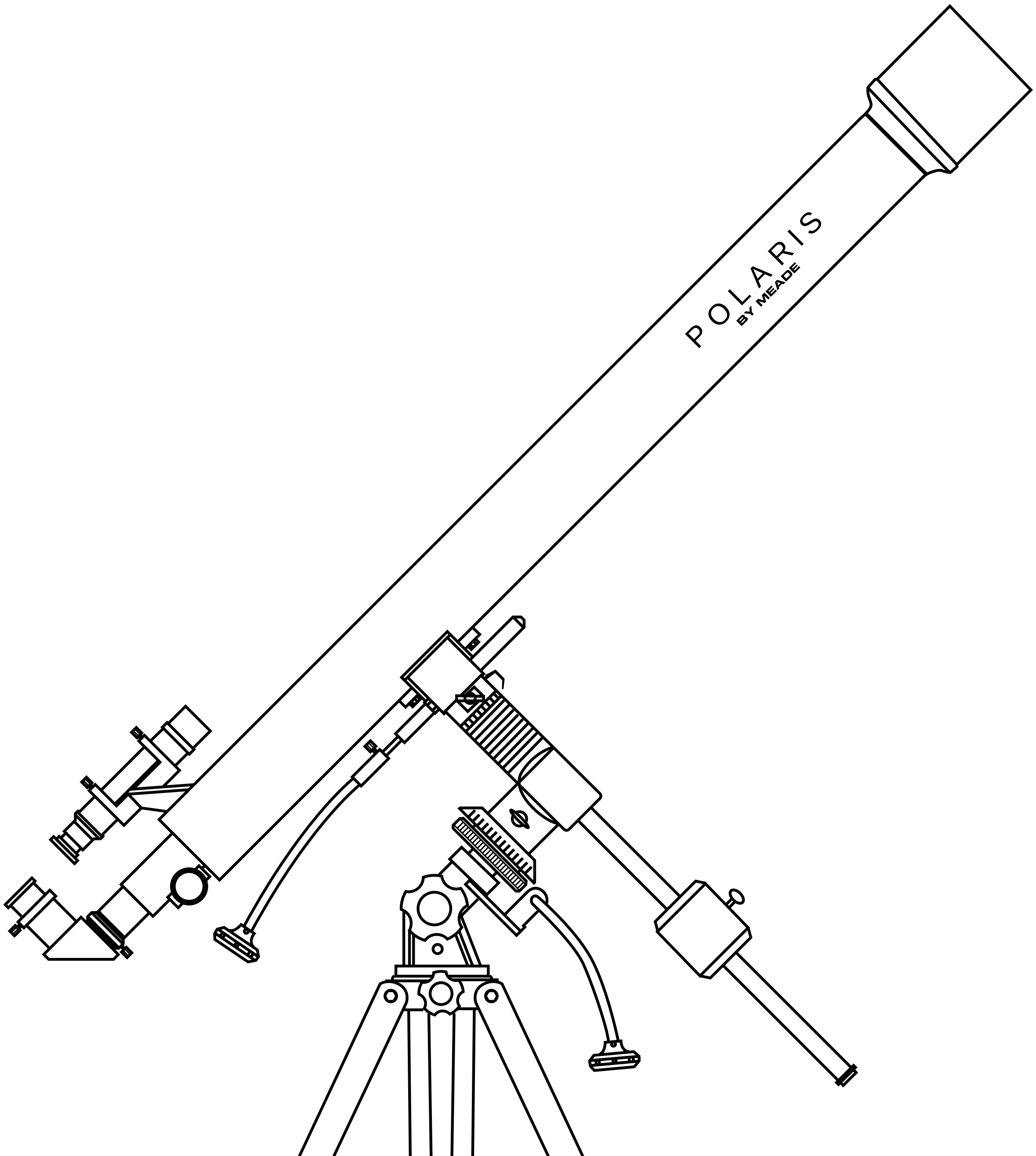
Instruction Manual

Polaris 60EQ-D: 2.4" (60mm) Equatorial Refracting Telescope



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6/02

WARNING:

NEVER ATTEMPT TO OBSERVE THE SUN THROUGH YOUR TELESCOPE! OBSERVING THE SUN, EVEN FOR THE SHORTEST FRACTION OF A SECOND, WILL CAUSE INSTANT AND IRREVERSIBLE EYE DAMAGE, AS WELL AS PHYSICAL DAMAGE TO THE TELESCOPE ITSELF. WHEN OBSERVING DURING THE DAYTIME, DO NOT POINT THE TELESCOPE EVEN CLOSE TO THE SUN.

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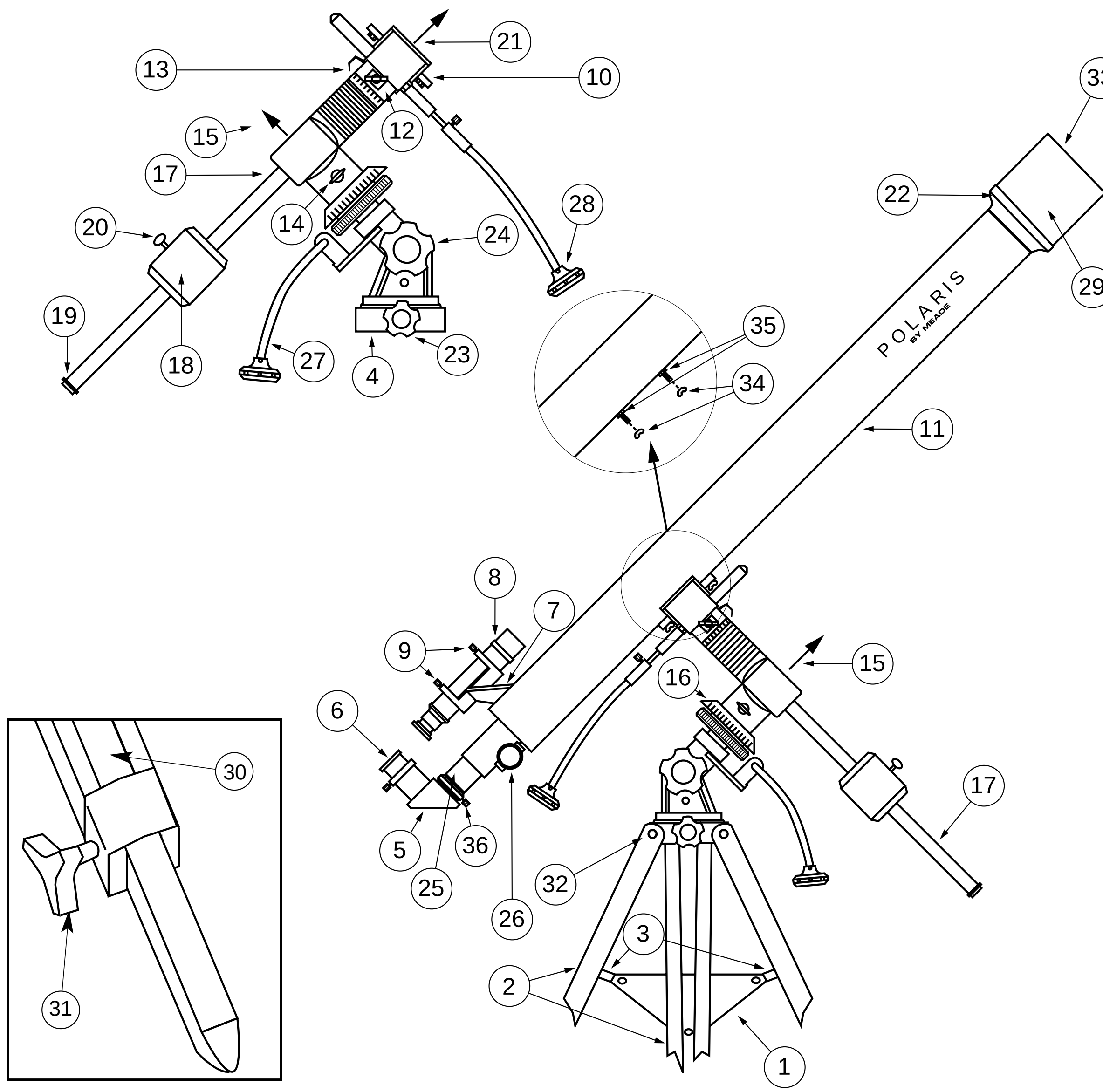

Figure 1: Polaris 60EQ-D 2.4" Equatorial Refracting Telescope

1. Accessory tray
2. Tripod legs
3. Leg brace/accessory tray supports
4. Tripod-to-mount base attachment point
5. Diagonal mirror
6. Eyepiece
7. Viewfinder bracket
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INTRODUCTION

This manual details the set-up, operation, specifications and optional accessories of the Polaris 60EQ-D 2.4" (60mm) Equatorial Refracting Telescope.

STANDARD EQUIPMENT

- Complete optical tube assembly (objective lens diameter = 60mm; focal length = 900mm)
- Full-length, fully adjustable, aluminum tripod and accessory tray
- SR4mm (225x), H12.5mm (72x), and H25mm (36x) Eyepieces (.965" O.D. "Outside Diameter")
- 3X Barlow lens (.965" O.D.)
- Diagonal mirror (.965" O.D.)
- 5x24mm viewfinder with bracket
- Complete equatorial mount with counterweight assembly
- Flexible control cables on both axes
- Hardware package: A. 3 bolts (3" long) with wing nuts and washers
  B. 3 screws (1/2" long) with wing nuts and screwdriver tool
- StarFinder astronomy software (separate instructions supplied in software package)

UNPACKING AND ASSEMBLY (Numbers in brackets below refer to Fig. 1)

1. Remove and identify the telescope's components, using the listing above.
2. Attach the 3 aluminum tripod legs (2) to the base of the equatorial mount (4) with the 3 hinged leg braces (3) facing inward. Three bolts (32) each about 3" long, with washers and wing nuts, are provided for this purpose in hardware package "A." Stand the telescope mount upright, spreading the tripod legs evenly apart so the accessory tray can be positioned to attach to the 3 leg braces.
3. Attach the accessory tray (1) to the leg brace supports (3) with the 3 short screws and wing nuts provided in hardware package "B." Place the accessory tray on top of one of the leg braces (3) of the tripod so that the mounting screw passes through the hole at one of the corners of the accessory tray (1), and through the hole at the end of the leg brace (3). Then thread-on and tighten the wing nut. Repeat this procedure until all 3 corners are mounted to the 3 leg braces.
4. Extend the sliding inner portion of the adjustable height tripod leg (30) to the desired length for all 3 legs. Lock in place by tightening the leg lock thumbscrew (31) for each leg.
5. Holding the counterweight (18) firmly in one hand, slip the counterweight onto the counterweight shaft (17). Attach the counterweight and counterweight shaft, by supporting the unlocked (20) counterweight firmly in one hand while threading the counterweight shaft into the base of the Declination axis of the telescope's equatorial mount. Once firmly attached, slide the counterweight about 2 inches from the bottom of the counterweight shaft and secure it in place with the locking thumbscrew (20) of the counterweight. Note: if the counterweight ever slips, the secured threaded safety washer/screw (19) will not let the weight slide entirely off the counterweight shaft. **Be certain that this safety washer/screw is always in place.**
6. Attach the flexible cables (27) and (28), as shown. These cables are secured in place with a firm tightening of the thumbscrews located at the attachment ends of each cable.
7. Tilt the polar axis (15) of the telescope to roughly a 45° angle with the horizon, as shown in Fig. 1. This tilt is accomplished by first loosening the lock control at (24); this lock control, called the "Latitude Adjustment Lock" is shown in Fig. 1 on top of page 4. With the polar axis thus tilted, firmly re-tighten the latitude control lock.
8. Remove the wing nuts (34) from the optical tube mounting bolts (35) that are the underside of the main optical tube (11) of the telescope. Then lay the telescope optical tube assembly onto the saddle plate (10) passing the mounting bolts (35) through the holes in the saddle of the mount. Re-attach the wing nuts (34) to the mounting bolts, and tighten to a firm feel. Be sure the focuser portion of the optical tube is on the same side of the saddle as the slow-motion control cable in Declination (28), see Fig. 1.

9. Attach the viewfinder bracket (7) to the telescope using the 2 thumbscrews provided. These thumbscrews are pre-threaded into the telescope at the viewfinder location. The thumbscrews fit through the 2 holes at the base of the viewfinder bracket and thread into the main optical tube.
10. Insert the diagonal mirror (5) into the focuser drawtube (25) and the 25mm eyepiece (6) into the diagonal mirror. Secure each in place with a moderate tightening of the respective thumbscrews.

The telescope is now completely assembled. Before it can be affectively used, however, the viewfinder (8) must be aligned with the main telescope.

ALIGNING THE VIEWFINDER

The wide field of view provided by the 5 x 24mm viewfinder (8) permits easy object sighting prior to observation in the higher-power main telescope. To align the viewfinder, follow this procedure:

1. First remove the front lens dust cap (33) from the dew shield/lens shade (29). Then using the lowest power (25mm) eyepiece, point the *main* telescope at some well defined land target (*e.g.* the top of a telephone pole) at least 200 yards distant.
2. Look through the viewfinder (8) and tighten or loosen, as appropriate, the viewfinder's 6 collimation (alignment) screws (9) located on the finderscope bracket (7), until the cross hairs of the viewfinder are precisely centered on the same object already centered in the main instrument's field of view. Hint: center the front of the viewfinder in the bracket using the 3 front ring thumbscrews, then make final object centering adjustments with the back ring 3 thumbscrews.
3. With this alignment accomplished, objects located first in the wide-field viewfinder will then be centered in the main telescope's field of view. Focusing of objects in the viewfinder is accomplished by turning the threaded eyepiece of the viewfinder. (Note: The viewfinder presents an image which is upside-down; this is customary in all astronomical viewfinders).

BALANCING THE TELESCOPE

In order for the telescope to move smoothly on its mechanical axes, it must first be balanced as follows:

Note: If the counterweight is positioned as recommended on the previous page—the telescope is already approximately balanced.

1. Loosen the Right Ascension lock knob (14). With the R.A. lock loosened, the telescope mount will turn freely about the polar axis (15). Rotate the telescope about the polar axis so that the counterweight shaft (17) is parallel to the ground (horizontal).
2. Loosen the counterweight's locking thumb screw and slide the counterweight (18) along the shaft (17) until the telescope remains in any given position without tending to drift down in either rotational direction about the polar axis. Then retighten the counterweight lock screw (20), locking the counterweight in position.

The telescope is now balanced.

UNDERSTANDING CELESTIAL MOVEMENTS AND COORDINATES

Understanding where to locate celestial objects, and how those objects move across the sky is fundamental to enjoying the hobby of astronomy. Most amateur astronomers adopt the simple practice of "star-hopping" to locate celestial objects by using star charts or astronomical software which identify bright stars and star patterns (constellations) that serve as "road maps" and "landmarks" in the sky. These visual reference points guide amateur astronomers in their search for astronomical objects. And, while star-hopping is the preferred technique, a discussion of using setting circles for locating objects is desirable since your telescope is provided with this feature. However, be advised, compared to star-hopping, object location by use of setting circles requires a greater investment in time and patience to achieve a more precise alignment of the telescope's polar axis to the celestial pole. For this reason, in part, star-hopping is popular because it is the faster, easier way to become initiated in the hobby.

Understanding how astronomical objects move: Due to the Earth's rotation, celestial bodies appear to move from East to West in a curved path through the skies. The path they follow is known as their line of

Right Ascension (R.A.). The angle of this path they follow is known as their line of Declination (Dec.). Right Ascension and Declination is analogous to the Earth-based coordinate system of latitude and longitude.

Understanding celestial coordinates: Celestial objects are mapped according to the R.A. and Dec. coordinate system on the “celestial sphere,” the imaginary sphere on which all stars appear to be placed.

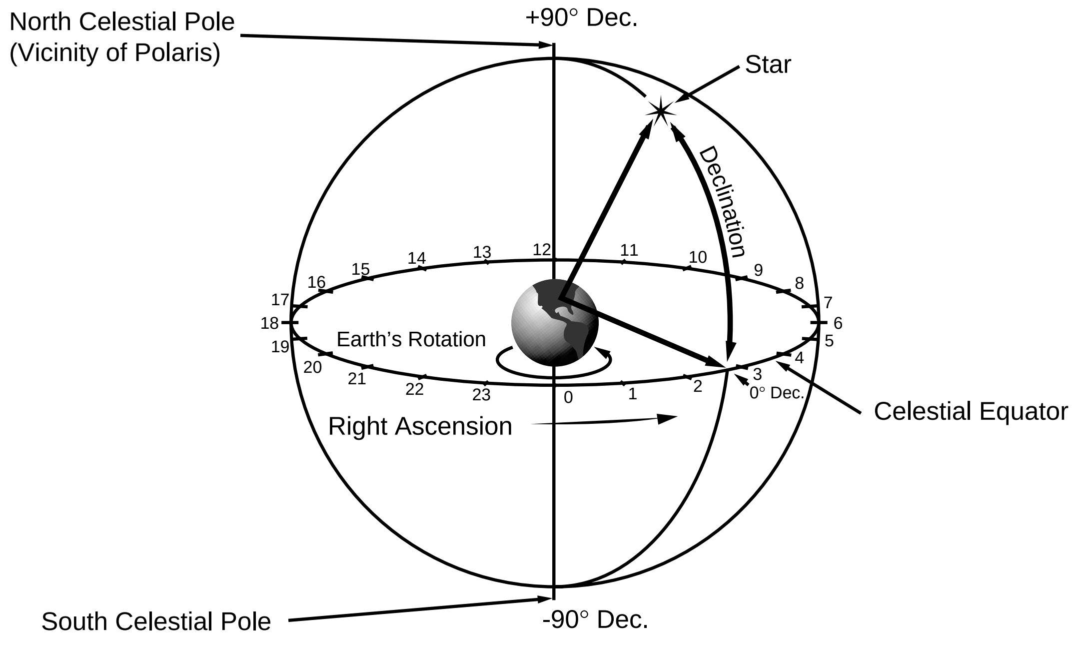

Figure 2: Celestial Sphere

The Poles of the celestial coordinate system are defined as those 2 points where the Earth's rotational axis, if extended to infinity, North and South, intersect the celestial sphere. Thus, the North Celestial Pole is that point in the sky where an extension of the Earth's axis through the North Pole intersects the celestial sphere. In fact, this point in the sky is located near the North Star, or Polaris.

On the surface of the Earth, “lines of longitude” are drawn between the North and South Poles. Similarly, “lines of latitude” are drawn in an East-West direction, parallel to the Earth's equator. The celestial equator is simply a projection of the Earth's equator onto the celestial sphere. Just as on the surface of the Earth, imaginary lines have been drawn on the celestial sphere to form a coordinate grid. Celestial object positions on the Earth's surface are specified by their latitude and longitude.

The celestial equivalent to Earth latitude is called “Declination,” or simply “Dec,” and is measured in degrees, minutes or seconds north ("+") or south ("-") of the celestial equator. Thus any point on the celestial equator (which passes, for example, through the constellations Orion, Virgo and Aquarius) is specified as having 0°0'0" Declination. The Declination of the star Polaris, located very near the North Celestial Pole, is +89.2°.

The celestial equivalent to Earth longitude is called “Right Ascension,” or “R.A.” and is measured in hours, minutes and seconds from an arbitrarily defined “zero” line of R.A. passing through the constellation Pegasus. Right Ascension coordinates range from 0hr0min0sec up to (but not including) 24hr0min0sec. Thus there are 24 primary lines of R.A., located at 15 degree intervals along the celestial equator. Objects located further and further east of the prime (0h0m0s) Right Ascension grid line carry increasing R.A. coordinates.

With all celestial objects therefore capable of being specified in position by their celestial coordinates of Right Ascension and Declination, the task of finding objects (in particular, faint objects) in the telescope can be simplified. The setting circles, R.A. (16) and Dec. (13) of the Polaris 60EQ-D telescope may be dialed, in effect, to read the object’s coordinates, positioning the object in the vicinity of the telescope’s telescopic field of view. However, these setting circles may be used to advantage only if the telescope is first properly aligned with the North Celestial Pole.

LINING UP WITH THE CELESTIAL POLE

Objects in the sky appear to revolve around the celestial pole. In northern latitudes the North Star (Polaris) approximates the pole. (Actually, celestial objects are essentially “fixed,” and their apparent motion is caused by the Earth's axial rotation). During any 24 hour period, stars make one complete revolution about the pole, making concentric circles with the pole at the center. By lining up the telescope's polar axis with the North Celestial Pole (or for observers located in Earth's Southern Hemisphere with the South Celestial Pole), astronomical objects may be followed, or tracked, simply by moving the telescope about one axis, the polar axis.

If the telescope is reasonably well aligned with the pole, therefore, very little use of the telescope's Declination flexible cable control is necessary — virtually all of the required telescope tracking will be in Right Ascension. (If the telescope were perfectly aligned with the pole, no Declination tracking of stellar objects would be required). For the purposes of casual visual telescopic observations, lining up the telescope's polar axis to within a degree or two of the pole is more than sufficient: with this level of pointing accuracy, the telescope can track accurately by slowly turning the telescope's R.A. flexible cable control and keep objects in the telescopic field of view for perhaps 20 to 30 minutes.

POLAR ALIGNMENT OF THE EQUATORIAL MOUNT

To line up the Polaris 60EQ-D with the pole, follow this procedure:

1) Release the Azimuth lock (23) of the Azimuth base, so that the entire telescope-with-mounting may be rotated in a horizontal direction. *Rotate the telescope until the polar axis (15) points due North.* Use a compass or locate Polaris, the North Star (see Fig. 3), as an accurate reference for due North.
2) Level the mount, if necessary, by adjusting the heights of the three tripod legs.
3) Determine the latitude of your observing location by checking a road map or atlas. Release the latitude lock (24) and tilt the telescope mount so that the star “Polaris” is centered in the telescope’s viewfinder eyepiece, then re-tighten the latitude lock (24).
4) If steps (1) - (3) above were performed with reasonable accuracy, your telescope is now sufficiently well-aligned to the North Celestial Pole for visual observations.

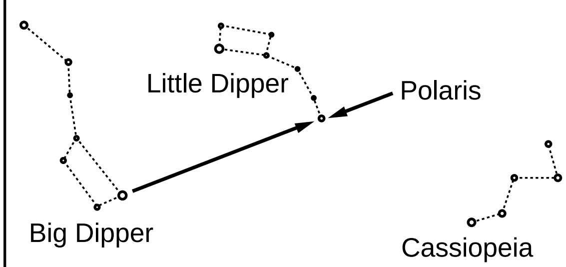

Figure 3: Finding Polaris

Once the mount has been polar-aligned as described above, the latitude angle need not be adjusted again, unless you move to a different geographical location (i.e. a different latitude). The only polar alignment procedure that need be done each time you use the telescope is to point the polar axis due North, as described in step (1) above.

USING THE TELESCOPE

1. With the telescope aligned to the Pole, you are now ready to begin observations.
   a. First, decide on an easy to find object. Land objects, during the daytime are a good way to become accustomed to the functions and operations of the telescope. At night, try observing the Moon, if it is visible, or a bright star.
   b. Slightly loosen the telescope’s R.A. lock (14) and Declination lock (12), located near the Declination setting circle (13). With a slight amount of hand-pressure the telescope should now be able to turn freely on its 2 axes.
   c. Using the aligned viewfinder, sight-in the object you have chosen. With the object centered on the viewfinder’s cross hairs, re-tighten the R.A. and Declination locks.
   d. The object should now be somewhere in the main telescope’s field of view. Next, using the 25mm

eyepiece, precisely center the object in the main telescope's field of view, and sharply focus the image by turning the focus knob (26). The 25mm eyepiece included as standard equipment is the best eyepiece to use for the initial finding and centering of any object. The 25mm eyepiece presents a bright, wide field of view, ideal for terrestrial and general astronomical observing of star fields, clusters of stars, nebulae, and galaxies. For lunar and planetary viewing, switch to a higher power eyepiece such as the H12.5mm–conditions permitting. If the image starts to become fuzzy as you work into higher magnifications, then back down to a lower power; the atmospheric steadiness is not sufficient to support higher powers at the time you are observing.

e. Note that the object immediately starts to drift out of the field of view. This motion is caused by the Earth's rotation. To "track" the object and keep it in the field of view, turn the R.A. slow motion control cable (27). Objects will appear to move through the field more rapidly at higher powers. Note: the Declination flexible cable control (28) is used only for centering purposes, and not for tracking.

2. Avoid touching the eyepiece while observing through the telescope. Vibrations resulting from such contact will cause the image to move. Likewise, avoid observing sites where ground-based vibrations may resonate the tripod. Viewing from the upper floors of a building may also introduce image movement.
3. Allow a few minutes for your eyes to become "dark adapted" prior to attempting any serious observations. Use a red-filtered flashlight to protect your night vision when reading star maps, or inspecting components of the telescope.
4. Avoid setting up the telescope inside a room and observing through an open window (or worse yet, a closed window). Images viewed in such a manner may appear blurred or distorted due to temperature differences between inside and outside air. Also, it is a good idea to allow your telescope a chance to reach the ambient (surrounding) outside temperature before starting an observing session.
5. **Warning! Never attempt to observe the sun through your Polaris 60EQ-D telescope. Observing the sun, even for the smallest fraction of a second, will cause instant and irreversible eye damage as well as physical damage to the telescope.**
6. Certain atmospheric conditions can distort an observed image. Planets, in particular, viewed while low on the horizon often exhibit lack of sharpness—the same object when observed higher in the sky will appear to be much better resolved with far greater contrast. Also, turbulent air in the upper atmosphere can cause the images to "shimmer" in the eyepiece—reduce power until the image steadies. Keep in mind that a bright, clearly resolved, but smaller image will show far more interesting detail than a larger, dimmer, fuzzy image.
7. Setting Circles: These etched dials (13) and (16), Fig. 1, aid in the location of faint celestial objects, perhaps, not easily found by direct visual observation. To use the setting circles, follow this procedure:
   a. Using a star chart or star atlas, look up the celestial coordinates (Right Ascension and Declination) of an easy to find object, such as a bright star.
   b. With the telescope aligned to the Pole, center the object in the telescope's field of view.
   c. Manually turn the R.A. setting circle to read the R.A. of the object now in the telescopic field.
   d. The setting circles are now calibrated. (Note that the Declination circle is factory pre-calibrated). To locate a faint object using the setting circles, determine the object's celestial coordinates from a star chart and move the telescope in R.A. and Declination until the setting circles read the R.A. and Declination of the object you are attempting to locate. If the above procedure has been carefully performed, the faint object will now be located in the vicinity of the telescope's telescopic field in a low power eyepiece.
   e. The R.A. circle must be re-calibrated to the R.A. of a known object each time the setting circles are used, which may be several times in one observing session.

APPLICATIONS OF THE TELESCOPE

The Polaris 60EQ-D may be used for a lifetime of rewarding astronomical observing, but basic to your enjoyment of the telescope is a good understanding of the instrument. Read the above instructions carefully until you understand all the telescope's parts and functions. One or two observing sessions will serve to clarify these points forever in your mind.

The number of fascinating objects visible through your Infinity refractor is limited only by your own motivation. Astronomical software, or a good star atlas (see “Meade Star Charts” in OPTIONAL ACCESSORIES, page 11) will assist you in locating many interesting celestial objects. These objects include:

- Cloud belts across the surface of the planet Jupiter.
- The 4 major satellites of Jupiter, visible in revolution about the planet, with the satellite positions changing each night.
- Saturn and its famous ring system, as well as several satellites of Saturn, much fainter than the major satellites of Jupiter.
- The Moon: A veritable treasury of craters, mountain ranges and fault lines. The best contrast for viewing the Moon is during its crescent phase. The contrast during the full Moon phase is low due to the angle of illumination.
- Deep-Space: Nebulae, galaxies, multiple star systems, star clusters—hundreds of such objects can be located through the Polaris 60EQ-D.
- Terrestrial Objects: Your Polaris refractor may also be used for the observation of land subjects. In this case, note that the diagonal mirror results in an image which is reversed left-for-right, but which is correctly oriented up-and-down. For a fully corrected image, the #927 Erect Image Prism system is required. (See “OPTIONAL ACCESSORIES”). Terrestrial observations should almost always be made using a low power eyepiece for bright, sharp images. Land objects will not normally accept higher powers because the telescope is being used through the thickest part of the Earth’s atmosphere, unlike astronomical observations made by pointing the telescope up through the atmosphere.

CALCULATING POWER

The power, or magnification, at which a telescope is operating is determined by 2 factors: the optical, or focal, length of the telescope’s objective lens and the focal length of the eyepiece. The focal length of the Polaris 60EQ-D is 900mm. To compute power, divide the focal length of the eyepiece into the focal length of the objective lens. The resulting quotient is the magnifying power of the telescope when used with the eyepiece in question. For example, the 25mm eyepiece yields, with the Polaris 60EQ-D, a power of:

$$\text{Power} = 900\text{mm} \div 25\text{mm} = 36\text{X}$$

The letter “H” refers to the “Huygens” optical design which yields well corrected images with refracting telescopes. The optical design of the eyepiece has no bearing on power, however.

The Barlow lens serves to increase the power of each eyepiece. Insert the 3X Barlow lens into the telescope focuser first, followed by the diagonal prism and eyepiece, secure by tightening the respective thumbscrews. For example, the 25mm (36X) eyepiece, when used in conjunction with the 3X Barlow Lens, yields 108X.

A few words of wisdom about power. While the theoretical power or magnification of a telescope is virtually limitless, there are, however, practical limits imposed by the Earth’s atmosphere as to what can be seen well at a given power. The most often useful higher magnification with any 60mm diameter telescope is in the range of 80 to 120 power. The general rule to follow with any telescope, regarding power: only use as much magnification as supports a steady, well-defined image. This often varies with the stability of the air being viewed through and is one reason why having various eyepieces is highly desirable. Higher powers are no guaranty of better images; in fact, the opposite is often true. Also, keep in mind, that land viewing and wide-field, deep-space observation are, generally, low power applications of your telescope.

MAINTENANCE

As with any quality optical instrument, lens surfaces should be cleaned as infrequently as possible. A little dust on the surface of the objective (front) lens causes negligible degradation of image quality and should not be considered reason to “clean” the lens. When lens cleaning does become necessary, use a camel’s hair brush or compressed air blown gently to remove dust. Wipe only with a soft, clean cloth, applying as little pressure as possible to avoid scratching glass surfaces. Note: remove the dew shield/lens shade (29) to access the objective lens (22) for cleaning.

SPECIFICATIONS

Focal Length 900mm
Aperture (Diameter) . . . . .60mm (2.4”)
f/ratio f/15
Mounting Type . . . . .Equatorial

OPTIONAL ACCESSORIES

See your Infinity or full-service Meade dealer for further details on any of these accessories.

Additional Eyepieces (.965"): Meade recommends the following eyepieces for enhanced astronomical and/or terrestrial viewing:

- MA9mm (.965"): Provides high quality, higher power, close-up observation of the Moon and planets (100x).
- MA40mm (.965"): Offers the most dramatic, wide field of view for observing deep-space objects. This is also the eyepiece most recommended for viewing of objects on land (23x).

Basic Camera Adapter (.965” O.D.): Permits direct attachment of 35mm SLR cameras to the telescope. (Requires T-Mount for your specific brand of camera). Suitable for lunar disk and land photography.

#927 Erect Image Prism (.965” O.D.): For correctly oriented left-for-right images during terrestrial observations through the telescope.

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