POLAR ALIGNMENT

For extensive astronomical observing the telescope is best mounted in the polar configuration. In polar alignment the telescope is oriented so that the horizontal and vertical axes of the telescope are lined up with the celestial coordinate system (see Fig. 10).

To polar align the ETX-90EC it is essential to have an understanding of how and where to locate celestial objects as they move across the sky. This section provides a basic introduction to the terminology of polar-aligned astronomy, and includes instructions for finding the celestial pole and for following objects in the night sky using Declination and Right Ascension.

WARNING! Never use the Meade ETX-90EC Astro Telescope to look at the Sun! Looking at or near the Sun will cause *instant* and *irreversible* damage to your eye. Eye damage is often painless, so there is no warning to the observer that damage has occurred until it is too late. Do not point the telescope or its viewfinder at or near the Sun. Do not look through the telescope or its viewfinder as it is moving. Children should always have adult supervision while observing.

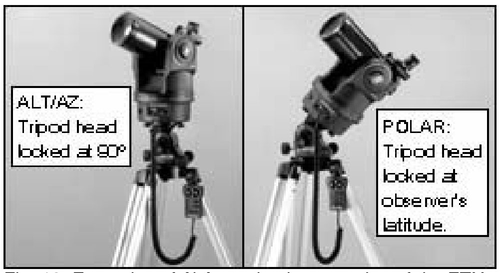


Fig. 12: Examples of AltAz and polar mounting of the ETX-90EC to the optional #883 Deluxe Field Tripod.

Celestial Coordinates

Celestial objects are mapped according to a coordinate system on the Celestial Sphere (Fig. 13), an imaginary sphere surrounding Earth on which all stars appear to be placed. This celestial object mapping system is analogous to the Earth-based coordinate system of latitude and longitude.

The poles of the celestial coordinate system are defined as those two points where the Earth's rotational axis, if extended to infinity, north and south, intersect the celestial sphere. Thus, the North Celestial Pole (1, Fig. 13) is that point in the sky where an extension of the Earth's axis through the North Pole intersects the celestial sphere. This point in the sky is located near the North Star, Polaris.

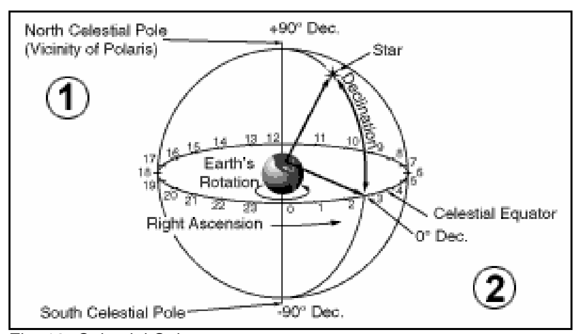


Fig. 13: Celestial Sphere.

In mapping 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 (2, Fig. 13) is a projection of the Earth's Equator onto the celestial sphere.

Just as on the surface of the Earth, in mapping the celestial sphere, imaginary lines have been drawn to form a coordinate grid. Thus, object positions on the Earth's surface are specified by their latitude and longitude. For example, you could locate Los Angeles, California, by its latitude (+34°) and longitude (118°); similarly, you could locate the constellation Ursa Major (which includes the Big Dipper) by its general position on the celestial sphere:

R.A.: 11hr; Dec: +50°.

- **Right Ascension:** The celestial analog to Earth longitude is called "Right Ascension," or "R.A.," and is measured in time on the 24 hour "clock" and shown in hours ("hr"), minutes ("min") and seconds ("sec") from an arbitrarily defined "zero" line of Right Ascension passing through the constellation Pegasus. Right

Ascension coordinates range from 0hr 0min 0sec to 23hr 59min 59sec. 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 Right Ascension grid line (0hr 0min 0sec) carry increasing R.A. coordinates.

- **Declination:** The celestial analog to Earth latitude is called Declination, "Dec", and is measured in degrees, minutes and seconds (e.g., 15° 27' 33"). Declination shown as north of the celestial equator is indicated with a "+" sign in front of the measurement (e.g., the Declination of the North Celestial Pole is +90°), with Declination south of the celestial equator indicated with a "-" sign (e.g., the Declination of the South Celestial Pole is -90°). Any point on the celestial equator itself (which, for example, passes through the constellations Orion, Virgo and Aquarius) is specified as having a Declination of zero, shown as 0° 0' 0".

All celestial objects are specified in position by their celestial coordinates of Right Ascension and Declination.

Locating the Celestial Pole

To get basic bearings at an observing location, take note of where the sun rises (East) and sets (West) each day. After the site is dark, face north by pointing your left shoulder toward where the sun set. To precisely point at the pole, find the North Star (Polaris) by using the Big Dipper as a guide (Fig. 16).

Polar Alignment Procedure

As the Earth rotates once on its axis every 24 hours, astronomical objects appear to move across the sky in an arc. This apparent motion (see Sidereal Rate) is not obvious to the unaided eye, but viewed through a serious telescope such as the ETX-90EC, this motion is rapid indeed. If the motor drive has not been engaged, objects centered in the telescope's eyepiece move entirely out of the field of view in 30 to 160 seconds, depending on the magnification employed.

For easy tracking of astronomical objects the ETX-90EC should be polar aligned.

There are two mounting methods available to polar align the ETX-90EC: by use of the optional #883 Deluxe Field Tripod or the #880 Table Tripod (see OPTIONAL ACCESSORIES).

To Polar align using the #883 Deluxe Field Tripod (Fig. 12), follow the instructions provided with the tripod. To Polar align using the #880 Table Tripod, follow the procedure below.

1. Make sure the viewfinder is aligned with the ETX-90EC (see Aligning the Viewfinder).
2. Remove the two hole covers (13, Fig. 1) from the side of the drive base and thread the two identical fixed legs (4, Fig. 15) into these holes to a firm feel only.
3. Determine the latitude of the observing location from a road map, atlas, or from the Latitude Chart for Major Cities of the World; determining the latitude within about one degree is sufficient.
4. The #880 Table Tripod includes two adjustable tripod legs: The standard tripod leg is used at observing latitudes between 22° and 48.5° and has a dual latitude label attached (Fig. 14). The high-latitude tripod leg is shorter and is used at observing latitudes between 44° and 66°. Based on the observing latitude determined in step 3, set aside the tripod leg that is not to be used.
5. Two mounting holes are located on the bottom of the telescope drive base. Mount the appropriate adjustable tripod leg (as determined in step 4) to the drive base using the following latitudes:

   Standard Tripod Leg

   - 32.5° to 48.5° uses High-Latitude hole (2, Fig. 15).
   - 22° to 35.5° uses Alternate hole (3, Fig. 15).

High-Latitude Tripod Leg

- 56° to 66° uses High-Latitude hole.
- 44° to 55° uses Alternate hole.

Thread the appropriate leg into the required hole to a firm feel only.

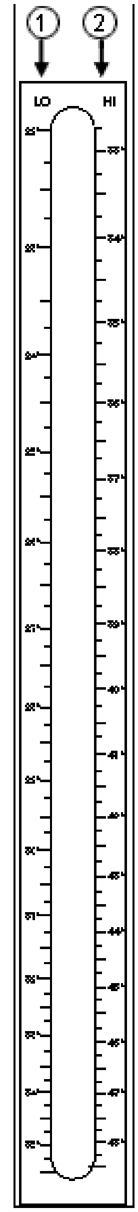


Fig. 14: Standard Tripod Leg: Latitude Scales

6. A small thumbscrew (6, Fig. 15) is attached to both the standard and high-latitude tripod legs. Loosening the thumbscrew allows the outer section of the leg to slide over the inner section, so that the length of the leg can be extended. If using the standard tripod leg, extend the leg so that the center of the thumbscrew-head is lined up with the latitude of the observing location on the scale. Then retighten the thumbscrew to a firm feel. (If using the high-latitude tripod leg, final adjustment of the leg extension is completed in step 9.)

   Example: The latitude of New York City is 41°. The tripod leg should be extended so that the center of the thumbscrew is set next to the 41° reading on the scale.

   CAUTION: Polar alignment at latitudes between 22° and 30° requires that the optional #1422 Low-Latitude Balance Weight (8, Fig. 15) be attached to the adjustable leg to stabilize the ETX-90EC for observing.

   NOTE: With the standard tripod leg threaded into the appropriate hole in the drive base, the latitude scale may be at an inconvenient position for reading (e.g., the scale may be facing the drive base). This situation can be remedied by unthreading the leg, removing the thumbscrew, rotating the inner leg 180°, then reinserting the thumbscrew. The scale should now be readable when threaded back into the telescope base.

7. Loosen the vertical and horizontal locks (6 and 10, Fig. 1) and rotate the telescope so that it is oriented as shown in Fig. 15. Tighten the vertical and horizontal locks. In this orientation the telescope's optical tube is lined up parallel to the tripod's adjustable leg.
8. Note the dotted line and arrow extending from the telescope tube in Fig. 15. This line defines the telescope's polar axis. Lift the entire telescope, including tripod, and place the telescope on a firm and level surface so that this axis is pointing due North. For example, if the location of Polaris, the North Star, is known then point the telescope directly at Polaris.
9. If using the high-latitude tripod leg in the northern hemisphere, extend the leg until the telescope's polar axis points to Polaris, or due North, an alignment obtained by sighting along the telescope tube with the telescope oriented as shown in Fig. 15.
10. *NOTE: Observer's located in the earth's southern hemisphere (e.g., South America, Australia, etc.) should point the telescope's polar axis due South.*
11. With the telescope now polar-aligned the tripod should not be moved, or else polar alignment will be lost. Motions of the telescope (e.g., to locate and/or track objects) should be effected only (a) by loosening the locks (6 and 10, Fig. 1), which permits the optical tube to be moved freely within the telescope mounting, or (b) generally, with the locks in their "locked" positions, by using the arrow keys of the Electronic Controller.

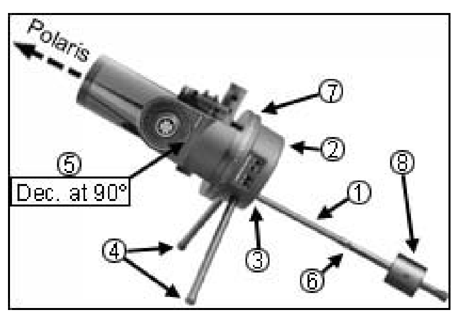


Fig. 15: Polar Alignment using the #880 Table Tripod. (1) Standard Tripod Leg with Latitude Scale; (2) High Latitude Hole; (3) Alternate Hole; (4) Fixed Tripod Legs; (5) Declination Pointer; (6) Thumbscrew; (7) R.A. Scale Pointer; (8) optional #1422 Low-Latitude Balance Weight.

table

more

Important Note: *For almost all astronomical observing requirements approximate settings of the telescope's latitude and polar axis are acceptable! Do not allow undue attention to precise polar alignment of the telescope to interfere with your basic enjoyment of the instrument.*

In those unusual cases where more precise polar alignment is desirable, refer to APPENDIX C.

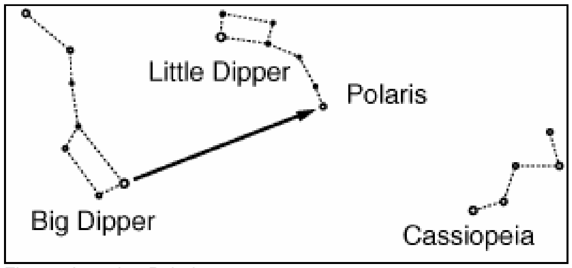


Fig. 16: Locating Polaris.

OBSERVING

OBJECTS IN SPACE

Listed below are some of the many astronomical objects that can be seen with the ETX-90EC.

WARNING! Never use the Meade ETX-90EC Astro Telescope to look at the Sun! Looking at or near the Sun will cause *instant* and *irreversible* damage to your eye. Eye damage is often painless, so there is no warning to the observer that damage has occurred until it is too late. Do not point the telescope or its viewfinder at or near the Sun. Do not look through the telescope or its viewfinder as it is moving. Children should always have adult supervision while observing.

The Moon

The Moon is, on average, a distance of 239,000 miles (380,000km) from Earth and is best observed during its crescent or half phase, when sunlight strikes its surface at an angle, casting shadows and adding a sense of depth to the view (Fig. 17). No shadows are seen during a full Moon, causing the overly bright Moon to appear flat and rather uninteresting through the telescope. Using the ETX-90EC, brilliant detail can be observed on the Moon, including hundreds of lunar craters and maria, described below.

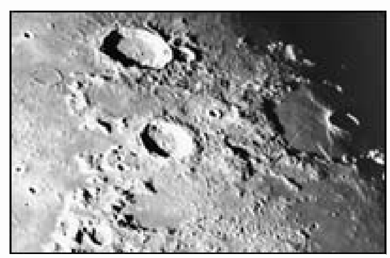


Fig. 17: Photo of the Moon shows rich detail afforded by shadows.

Craters are round meteor impact sites covering most of the Moon's surface. With no atmosphere on the Moon, no weather conditions exist, so the only erosive force is meteor strikes. Under these conditions, lunar craters can last for millions of years.

Maria (plural for *mare*) are smooth, dark areas scattered across the lunar surface. These dark areas are large ancient impact basins that were filled with lava from the interior of the Moon by the depth and force of a meteor or comet impact.

12 Apollo astronauts left their bootprints on the Moon in the late 1960's and early 1970's. However, no telescope on Earth is able to see these footprints or any other artifacts. In fact, the smallest lunar features that may be seen with the largest telescope on Earth are about one-half mile across.

NOTE: Except during its early or late crescent phases, the Moon can be an exceptionally bright object to view through the telescope. To reduce the brightness and glare, use the #905 Variable Polarizing Filter (see OPTIONAL ACCESSORIES).

Planets

Planets change positions in the sky as they orbit around the Sun. To locate the planets on a given day or month, consult a monthly astronomy magazine, such as Sky and Telescope or Astronomy. Listed below are the best planets for viewing through the ETX-90EC.

Venus is about nine-tenths the diameter of Earth. As Venus orbits the Sun, observers can see it go through phases (crescent, half, and full) much like those of the Moon. The disk of Venus appears white as sunlight is reflected off the thick cloud cover that completely obscures any surface detail.

Mars is about half the diameter of Earth, and appears through the telescope as a tiny reddish-orange disk. It may be possible to see a hint of white at one of the planet's polar ice caps. Approximately every two years, when Mars is closest to Earth in its orbit, additional detail and coloring on the planet's surface may be visible.

Jupiter is the largest planet in our solar system and is 11 times the diameter of Earth. The planet appears as a disk with dark lines stretching across the surface. These lines are cloud bands in the atmosphere. Four of Jupiter's 16 moons (Io, Europa, Ganymede, and Callisto) can be seen as "star-like" points of light when using even the lowest magnification. These moons orbit Jupiter so that the number of moons visible on any given night changes as they circle around the giant planet.

Saturn is nine times the diameter of Earth and appears as a small, round disk with rings extending out from either side. In 1610, Galileo, the first person to observe Saturn through a telescope, did not understand that what he was seeing were rings. Instead, he believed that Saturn had "ears." Saturn's rings are composed of billions of ice particles ranging in size from a speck of dust to the size of a house. The major division in Saturn's rings, called the Cassini Division, is generally visible through the ETX-90EC. Titan, the largest of Saturn's 18 moons can also be seen as a bright, star-like object near the planet.

Deep-Sky Objects

Star charts can be used to locate constellations, individual stars and deep-sky objects. Examples of various deep-sky objects are given below:

Stars are large gaseous objects that are self-illuminated by nuclear fusion in their core. Because of their vast distances from our solar system, all stars appear as pinpoints of light, irrespective of the size of the telescope used.

Nebulae are vast interstellar clouds of gas and dust where stars are formed. Most impressive of these is the Great Nebula in Orion (M42), a diffuse nebula that appears as a faint wispy gray cloud. M42 is 1600 light years from Earth.

Open Clusters are loose groupings of young stars, all recently formed from the same diffuse nebula. The Pleiades (Fig. 18) is an open cluster 410 light years away. Through the ETX-90EC several hundred stars are visible.

Constellations are large, imaginary patterns of stars believed by ancient civilizations to be the celestial equivalent of objects, animals, people, or gods. These patterns are too large to be seen through a telescope. To learn the constellations, start with an easy grouping of stars, such as the Big Dipper in Ursa Major. Then, use a star chart to explore across the sky.

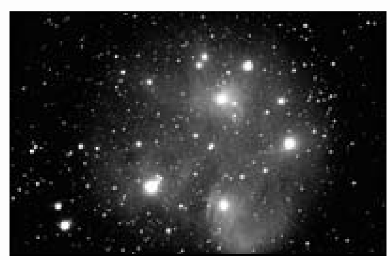


Fig. 18: The Pleiades Star Cluster (M45) in the constellation Taurus.

Galaxies are large assemblies of stars, nebulae, and star clusters that are bound by gravity. The most common shape is spiral (such as our own Milky Way), but galaxies can also be elliptical, or even irregular blobs. The Andromeda Galaxy (M31) is the closest spiral-type galaxy to our own. This galaxy appears fuzzy and cigar-shaped. It is 2.2 million light years away in the constellation Andromeda, located between the large "W" of Cassiopeia and the great square of Pegasus. Under clear, dark conditions, M31 can be seen with the naked eye and is a fascinating object through the ETX-90EC.

PHOTOGRAPHY WITH THE ETX-90EC

Photography through the ETX-90EC requires the addition of the optional #64 T-Adapter (see OPTIONAL ACCESSORIES). With the #64 T-Adapter attached to the telescope (Fig. 19), through-the-telescope photography is possible with any 35mm camera body with a removable lens. In this way the telescope effectively becomes the lens of the camera.

For through-the-telescope photography, turn the flip-mirror control, (5, Fig. 19) to the "down" position, allowing light to pass straight through the telescope and out the photo port (17, Fig. 1). With the flip-mirror control in the "down" position and the photo port's dust cover removed, the front lens of the telescope can be seen when looking through the photo port. The #64 T-Adapter threads on to the photo port, followed by a T-Mount for the particular brand of 35mm camera being used, followed in turn by the camera body itself (with camera lens removed).

Note that the #64 T-Adapter consists of two sections (1 and 2, Fig. 19) which are threaded together in shipment. Either of the following photographic mounting formats may be used to couple the camera body to the telescope's photo port thread.

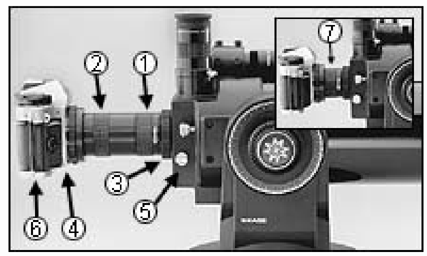


Fig. 19: Using the #64 T-Adapter. (1) Short Section of #64 T-Adapter; (2) Extension Section of #64 T-Adapter; (3) Knurled Attachment Ring; (4) T-Mount; (5) Flip-Mirror Control in "down" position; (6) 35mm Camera Body; (7) Inset shows Format 1.

- **Format 1** (1250mm focal length): *Camera Body + T-Mount + Section (1) of the #64 T-Adapter (7, Fig. 19).* Format 1 utilizes the short section only of the #64 T-Adapter to permit close-coupling of a camera body to the telescope at an effective photographic speed of f/14 and a transmission value (the so-called "T"-value) of 18. In this format vignetting will occur: the photographic image will appear on film with a slight darkening at the corners of the 35mm frame (see Fig. 20).
- **Format 2** (1450mm focal length): *Camera Body + T-Mount + Sections (1) and (2) of the #64 T-Adapter (see Fig. 19).* Format 2 utilizes both sections of the #64 T-Adapter threaded together to form a rigid unit as shown in Fig. 19, the telescope is operating at a photographic speed of f/16 and T-value of 23, but without any field vignetting: images are illuminated to the edges of a standard 35mm frame (see Fig. 21).

To frame an object in the viewfinder of the 35mm camera body, loosen slightly the knurled ring (3, Fig. 19) which threads the #64 T-Adapter to the telescope's photo port; rotate the camera body to achieve proper framing of the object; then re-tighten the knurled ring.

Photography through a long lens such as the ETX-90EC requires special technique for good results, and the photographer should probably expect to waste a roll or two of film in acquiring this technique. Long-lens photography has its own rewards, however; rewards that short-focus lenses can not duplicate.

A few tips on photography through the ETX-90EC:

1. Use a rigid tabletop or the optional #883 Deluxe Field Tripod as a platform for the telescope. At effective focal lengths of 1250mm (Format 1) and 1450mm (Format 2), even small external vibrations can easily ruin an otherwise good photo.

   CAUTION: With the #64 T-Adapter and a camera body mounted to the ETX-90EC photo port, the telescope can only be rotated vertically 45°. Moving past this point may damage the telescope and camera.

2. Use a cable-operated shutter release. Touching the camera body to initiate shutter operation will almost certainly introduce undesirable vibrations.

3. Focus the image with extreme care. While observing the subject through the camera's reflex viewfinder, turn the ETX-90EC's focus knob (9, Fig. 1) to achieve the sharpest possible focus. Note that some 35mm cameras may have an optional focusing screen (available from the manufacturer) for use with a long telephoto lens. This screen provides a brighter and clearer image to focus and is highly recommended.
4. Correct shutter speeds vary widely, depending on lighting conditions and film used. Trial-and-error is the best way to determine proper shutter speed in any given application.

    NOTE: The camera used with the ETX-90EC may have a built-in exposure meter that is still active when the standard lens is removed and the body is connected to the telescope with the T-Mount. If used for terrestrial photography, the camera meter should be acceptable. If used for astrophotography, the meter probably will not provide good results since camera meters are not made to compensate for a dark sky.

5. Terrestrial photography through the ETX-90EC is sensitive to heat waves rising from the earth's surface. Long distance photography is best accomplished in the early morning hours before the earth has had time to build up heat.
6. Photography of the Moon and planets through the ETX-90EC can be especially gratifying, but points 1 through 4 should be particularly noted in this case. Lunar or planetary photography requires that the telescope be polar aligned (see [Polar Alignment Procedure]), and that the telescope's motor drive be in operation (see [Electronic Controller Modes]).

    NOTE: Long exposure photography of deep-sky objects is not practical with the ETX-90EC, since this type of photography requires special electronic and optical guiding devices not available for this telescope.

Fig. 20: Example of Format 1 Photo (1250mm).

Fig. 21: Example of Format 2 Photo (1450mm).

OPTIONAL ACCESSORIES

A wide assortment of professional Meade accessories is available for the ETX-90EC. Meade accessories greatly extend many important applications to the telescope, from low-power, wide-field terrestrial viewing to high-power lunar and planetary observing. The premium quality of these accessories is well-suited to the quality of the instrument itself.

Meade telescopes and accessories, including optional accessories for ETX-series telescopes are available at more than 2000 dealer locations in the U.S. and Canada and through Meade international distributors worldwide.

WARNING! Never use the Meade ETX-90EC Astro Telescope to look at the Sun! Looking at or near the Sun will cause *instant* and *irreversible* damage to your eye. Eye damage is often painless, so there is no warning to the observer that damage has occurred until it is too late. Do not point the telescope or its viewfinder at or near the Sun. Do not look through the telescope or its viewfinder as it is moving. Children should always have adult supervision while observing.

Eyepieces: Meade Super Plössl (SP), Super Wide Angle (SWA), and Ultra Wide Angle (UWA) Eyepieces in the standard American-size (1.25") barrel diameter (Fig. 23) permit a wide range of magnifying powers with the ETX-90EC. Powers obtain-ed with each available eyepiece are shown in the following table:

Eyepiece	**Magnifying Power with ETX-90EC**	**With #126 2X Barlow Lens**
SP 6.4mm	195X	390X **
SP 9.7mm	129X	258X
SP 12.4mm	101X	202X
SP 15mm	83X	166X
SP 20mm	63X	126X
SP 26mm *	48X	96X
SP 32mm	39X	78X
SP 40mm	31X	62X
SWA 13.8mm	91X	182X
SWA 18mm	69X	138X
SWA 24.5mm	51X	102X
UWA 4.7mm	266X	N/A
UWA 6.7mm	187X	374X **

* Included as standard equipment with the ETX-90EC telescope.
** Use these eyepieces only under extremely steady atmospheric conditions.


Fig. 23: Optional eyepieces yield higher and lower magnifying powers with the telescope.

Meade Super Plössl and Super Wide Angle Eyepieces are ideal for general-purpose astronomical or terrestrial observing. The typical ETX-90EC user may wish to add two or three of these eyepieces to his or her telescope. An introductory selection might include the SP 9.7mm and SP 15mm eyepieces, while the more advanced observer might select the SP 9.7mm, SP 12.4mm, and SWA 18mm. Meade Super Wide Angle Eyepieces yield extremely wide fields of view, perfect for the examination of star fields, diffuse nebulae, or for terrestrial applications. Under steady seeing conditions Meade UWA 4.7mm and 6.7mm eyepieces present the widest fields of view obtainable at high powers and are excellent eyepieces for viewing the Moon and planets.

#126 2x Barlow Lens: An amplifying lens, the #126 2x Barlow Lens (Fig. 24) doubles the powers of each eyepiece with which it is used. Insert the #126 into the telescope's eyepiece-holder first, followed by an eyepiece. Example: By itself the SP 26mm eyepiece yields a power of 48X with the ETX-90EC; when used in conjunction with the #126 2x Barlow Lens, this eyepiece yields 96X.

The Meade #126 is an achromatic, high-performance, short-focus Barlow Lens, perfectly suited to the low-profile design of the ETX-90EC. Lens surfaces are multi-coated for maximum image contrast and light transmission.

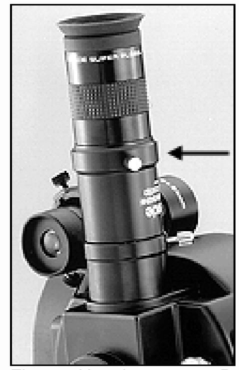


Fig. 24: Use the #126 2x Barlow Lens to double the magnification of the eyepiece employed.

Fig. 25: #825 Right-Angle Viewfinder.

#825 8 x 25mm Right-Angle Viewfinder: Similar in optical characteristics to the 8 x 21mm straight-through viewfinder supplied as standard-equipment with the ETX-90EC, the #825 right-angle viewfinder (Fig. 25) allows for a comfortable 90° viewing position. The #825 viewfinder replaces the standard-equipment 8 x 21mm viewfinder and fits into the same bracket on the telescope.

#64 T-Adapter: The #64 T-Adapter (1, Fig. 26) is the basic means of photography through the ETX-90EC. The adapter threads to the rear cell of the telescope, followed by a T-Mount appropriate to your brand of 35mm camera. With the #64 T-Adapter and T-Mount in place, the camera body is rigidly coupled to the telescope's optical system, which in effect becomes the camera's lens.

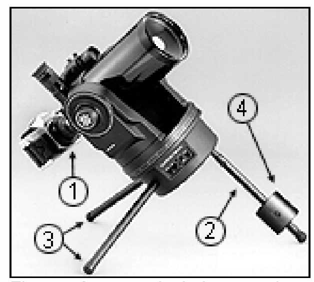


Fig. 26: Astronomical photography with the ETX. (1) #64 T-Adapter; (2) Standard Tripod Leg; (3) Fixed Tripod Legs; (4) #1422 Low-Latitude Balance Weight.

#880 Table Tripod: Lightweight and extremely portable, the #880 Table Tripod (2 and 3, Fig. 26) attaches quickly to the telescope drive base and provides a sturdy platform for astronomical viewing. Two identical fixed tripod legs (3, Fig. 26) mount to holes on the side of the drive base. The adjustable standard tripod leg (2, Fig. 26), with its two latitude scales, is mounted to one of two holes on the bottom of the drive base and permits the telescope to be polar aligned for latitudes between 22° and 48.5°. At higher observing latitudes the shorter high-latitude tripod leg, also included and shown in Fig. 27, is substituted for the standard tripod leg.

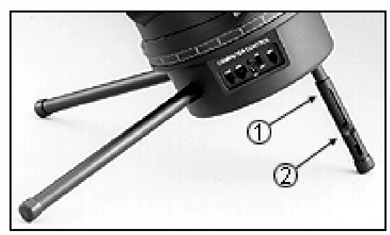


Fig. 27: (1) High-Latitude Tripod Leg; (2) Thumbscrew Lock.

#1422 Low-Latitude Balance Weight: If the ETX-90EC is to be used with the #880 Table Tripod and polar-aligned at latitudes below 30°, the telescope can become unbalanced, particularly if heavier accessories (e.g., a camera body) are attached to the eyepiece-end of the telescope. The #1422 Low-Latitude Balance Weight (4, Fig. 26) slides on to the standard tripod leg and enables rock-solid stability of the telescope even at lower latitudes.

#883 Deluxe Field Tripod: Manufactured of strong, lightweight extruded aluminum, the #883 Deluxe Field Tripod (Fig. 28) allows standing or seated observations through the ETX-90EC. Tripod height is continuously adjustable from 34" to 54". Micrometric controls in both azimuth and elevation-angle permit precise polar alignment of the telescope's fork mount for astronomical applications. Designed exclusively for ETX-series astronomical telescopes, the #883 Deluxe Field Tripod includes all the rigidity and stability required for high-power observing through the telescope. For terrestrial observing, where altazimuth orientation of the telescope is desirable, the tripod head tilts and locks at 90° (inset, Fig 28).

Fig. 28: The #883 Deluxe Field Tripod with ETX-90EC Telescope, set up in the Alt/Az configuration (tripod head locked at 90°), for terrestrial applications. (Inset) Tripod head tilted for polar alignment.

#882 Standard Field Tripod: (not shown) If the ETX-90EC is used primarily for terrestrial observing and less-extensively for astronomical viewing, the polar alignment capability of the #883 Deluxe Field Tripod may not be required. In this case the #882 Standard Field Tripod provides a rigid observing platform for the telescope in the altazimuth (Alt/Az) configuration, only. Alternately, if the telescope is equipped with the optional #497 ETX Autostar Computer Controller, astronomical sidereal-rate tracking can be effected in the Alt/Az configuration permitted with the #882 Standard Field Tripod, without any requirement for polar alignment. The #882 Standard Field Tripod is variable in height between 34" and 54" for seated or standing observing through the telescope.

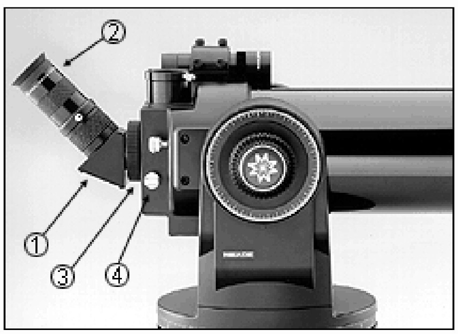


Fig. 29: The #932 45° Erecting Prism threaded to the rear cell of the ETX-90EC. (1) #932 45° Erecting Prism; (2) Eyepiece; (3) Knurled Lock-ring; (4) Flip-Mirror Control.

#932 45° Erecting Prism: If the ETX-90EC is to be used for extensive terrestrial applications, the #932 45° Erecting Prism (1, Fig. 29) is a useful accessory. Images through the 90° eyepiece-holder (4, Fig. 1) appear right-side-up, but reversed left-for-right. The #932 Prism threads on to the telescope's photo port (17, Fig. 1) and presents a correctly oriented image as well as a convenient 45° observing angle. An eyepiece of any focal length (magnifying power) may be inserted into the #932 Prism. Note that the flip-mirror control (4, Fig. 29) must be in the "down" position for use with the #932 Prism.

***Important Note:** In the most discriminating applications, such as in observing delicate bird feather-structure at long distance, the ETX-90EC's internal, optically-flat mirror yields a higher-resolution image than is possible with any prism, including the #932. In these special cases ETX-90EC users are advised to observe with the eyepiece in the standard 90° eyepiece-holder (as shown in Fig. 1), with the flip-mirror control in the "up" position. This admonition applies only to situations requiring extraordinarily high optical resolution and where the observer's eye is well-trained to observe very fine detail. In typical terrestrial applications, no image differences between the two eyepiece locations can generally be noted.*

#765 Soft Carrying Bag: Perfectly suited to field use of, or traveling with, the telescope, the soft-padded, Cordura-type #765 Soft Carrying Bag (Fig. 30) for the ETX-90EC includes a shoulder strap and permits ready transport of the complete telescope, including the table tripod, eyepieces, and other accessories. With the #765 Soft Carrying Bag the telescope can go anywhere with you at a moment's notice.

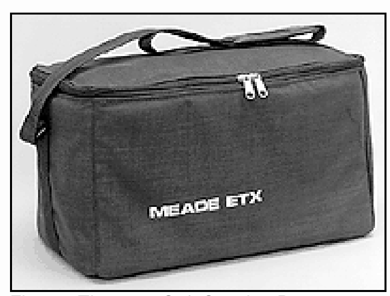


Fig. 30: The #765 Soft Carrying Bag.

Fig. 31: #774 Hard Carrying Case.

#774 Hard Carrying Case: For situations that require ruggedness and portability, the #774 Hard Carrying Case (Fig. 31) provides a secure environment for the ETX-90EC. The fitted foam interior protects the telescope while providing ample room for additional eyepieces, a table tripod, the Electronic Controller, ETX Autostar, and much more.

#607 DC Power Cord: To power the ETX-90EC from an automobile cigarette lighter plug, the #607 DC Power Cord (Fig. 32) is required. Supplied with 25 ft. cord.

Fig. 32: #607 DC Power Cord.

#541 AC Adapter: (not shown) The #541 AC Adapter permits powering of the ETX-90EC via a standard household (115vAC) electrical outlet. Supplied with 25 foot cord.

#1244 Electric Focuser: The #1244 Focuser (Fig. 33) replaces the manual focuser knob of the ETX-90EC and permits smooth, precise electric focusing of the image through a remote handbox supplied with the focuser. Alternately, on the ETX-90EC, the #1244 Focuser may be plugged into the telescope's computer control panel and operated through either the Electronic Controller or the optional #497 ETX Autostar Computer Controller.

Fig. 33: #1244 Electric Focuser.

Fig. 34: (1) #905 Variable Polarizing Filter; (2) Eyepiece.

#905 Variable Polarizing Filter: For glare reduction in observing the Moon the #905 Variable Polarizer (Fig. 34) includes two Polarizer filters mounted in a specially-machined cell. The #905 permits variable settings of light transmission between 5% and 25%, to account for varying lunar surface brightness according to the phase of the Moon. Accepts 1.25" barrel-diameter eye-pieces of any focal length.

Fig. 35: Epoch 2000sk software

Epoch 2000sk Sky Software: Meade Epoch 2000sk astro-nomical software (Fig. 35) has created a revolution in the way amateur astronomers prepare for observing sessions at the tele-scope. For Epoch 2000sk presents on the display of a personal computer an incredibly detailed simulation of the entire sky, including up to 281,000 celestial objects. Epoch 2000sk allows the presentation of the most complex star fields just as they actually appear through the telescope. And yet, notwithstanding its precision and detail, Epoch 2000sk is easy and intuitive to use, even by the novice. Epoch 2000sk operates the ETX-90EC through a laptop computer in the field using the #497 Autostar Computer Controller and #505 Connector Cable Set. Epoch 2000sk astronomical software is available in the following formats:

- **Epoch 2000sk-JR:** 10,000 objects supplied on 3.5" discs for Windows 3.1 or higher, or Windows 95.
- **Epoch 2000sk Sky Software:** 281,000 objects supplied on 3.5" discs for Windows 3.1 or higher, or Windows 95.
- **Epoch 2000sk-CD Sky Software:** Over 19 million objects supplied on CD-ROM for Windows 3.1 or higher, or Windows 95.

MAINTENANCE AND SERVICING

General Maintenance

WARNING! Never use the Meade ETX-90EC Astro Telescope to look at the Sun! Looking at or near the Sun will cause *instant* and *irreversible* damage to your eye. Eye damage is often painless, so there is no warning to the observer that damage has occurred until it is too late. Do not point the telescope or its viewfinder at or near the Sun. Do not look through the telescope or its viewfinder as it is moving. Children should always have adult supervision while observing.

The ETX-90EC is a precision optical instrument designed to yield a lifetime of rewarding applications. Given the care and respect due any precision instrument, the ETX-90EC will rarely, if ever, require factory servicing or maintenance. Maintenance guidelines include:

1. Avoid cleaning the telescope's optics: a little dust on the front surface of the telescope's correcting lens causes virtually no degradation of image quality and should not be considered reason to clean the lens.
2. When absolutely necessary, dust on the front lens should be removed with gentle strokes of a camel hair brush or blown off with an ear syringe (available at any pharmacy). Do not use a commercial photographic lens cleaner.
3. Organic materials (e.g., fingerprints) on the front lens may be removed with a solution of 3 parts distilled water to 1 part isopropyl alcohol. A single drop of biodegradable dishwashing soap may be added per pint of solution. Use soft, white facial tissues and make short, gentle strokes. Change tissues often.

    CAUTION: Do not use scented, colored, or lotioned tissues or damage could result to the optics.

4. In the very rare situation where cleaning the inside surface of the corrector lens becomes necessary, unthread the lens cell located at the front of the main tube. The entire correcting lens and secondary mirror system is mounted in this cell. The lens cleaner solution described in step 3 may be used to clean the inside surface of the lens.

   CAUTION: Do not touch the aluminized circular surface of the secondary mirror with a finger, a tissue, or any other object. Scratching of the mirror surface will almost certainly result.

   NOTE: When cleaning the inside surface of the correcting lens, leave the lens mounted in its metal cell throughout the process. Do not remove the lens from its metal housing or else optical alignment of the lens will be lost, necessitating a return of the telescope to the Meade factory.

5. If the ETX-90EC is used outdoors on a humid night, telescope surfaces may accumulate water condensation. While such condensation does not normally cause any damage to the telescope, it is recommended that the entire telescope be wiped down with a dry cloth before being packed away. *Do not, however, wipe any of the optical surfaces.* Rather, simply allow the telescope to sit for some time in warm indoor air, so that the wet optical surfaces can dry unattended. In addition, the dust cap should not be placed back on to the optical tube until the telescope is thoroughly dry.
6. If the ETX-90EC is not to be used for an extended period, perhaps for one month or more, it is advisable to remove the eight AA-size batteries from inside the drive base. Batteries left installed for prolonged periods may leak, causing damage to the telescope's electronic circuitry (see Assembly Instructions).
7. The super-gloss anodized finish of the ETX-90EC's deep-violet optical tube fades if left in direct sunlight for prolonged periods.
8. Do not leave the ETX-90EC telescope outdoors on a warm day or inside a sealed car for an extended period of time; excessive ambient temperatures can damage the telescope's internal lubrication and electronic circuitry.
9. A set of two (English-format) hex wrenches is provided with each ETX-90EC Astro Telescope. These wrenches are used as follows:
   - **Small wrench (.05"):** Use the small wrench to tighten the set-screws of any knobs which may loosen (e.g., the focus knob or flip-mirror control knob).
   - **Medium wrench (1/16"):** This wrench is used to detach the viewfinder bracket from the telescope's rear-cell.

Storage and Transport

When not in use, store the telescope in a cool, dry place. Do not expose the instrument to excessive heat or moisture. It is best to store the telescope in its original box with the vertical and horizontal locks (6 and 10, Fig. 1) in the unlocked positions. If shipping the telescope, use the original box and packing material to protect the telescope during shipment.

When transporting the telescope, take care not to bump or drop the instrument; this type of abuse can damage the optical tube and/or the objective lens. It is highly recommended to use the #765 Soft Carrying Bag or #774 Hard Carrying Case to transport the telescope (see OPTIONAL ACCESSORIES).

Inspecting the Optics

A Note About the "Flashlight" Test: If a flashlight or other high-intensity light source is pointed down the main telescope tube, the view (depending upon the observer's line of sight and the angle of the light) may reveal what appears to be scratches, dark or bright spots, or uneven coatings, giving the appearance of poor quality optics. These effects are only seen when a high intensity light is transmitted through lenses or reflected off the mirrors, and can be seen on any high quality optical system, including giant research telescopes.

The optical quality of a telescope cannot be judged by the "flashlight" test; the true test of optical quality can only be conducted through careful star testing.

Troubleshooting

The following suggestions may be helpful if there are difficulties with operation of the Electronic Controller or ETX-90EC telescope.

The power indicator light does not come on or there is no response when pressing the Electronic Controller arrow keys:

- Verify that the computer control panel power switch (1, Fig. 4) is in the ON position.
- Verify that the Electronic Controller cord (4, Fig. 5) is firmly connected to the HBX port (3, Fig. 4).
- If using internal power (batteries), verify that the batteries are installed correctly and that they have sufficient charge (see Assembly Instructions).

  NOTE: If the batteries are getting low on charge there will be a marked difference in the slew speed. The speed indicator lights may also flash and the speed may change. If any of these symptoms occurs, turn the power off and replace the batteries.

- If using an external power source, verify that it is properly connected between the 12 volt connector (4, Fig. 4) and either a wall plug (AC source) or a car lighter (DC source).
- If the Electronic Controller does not respond to commands, place the power switch to OFF and then back to ON.
- If the telescope does not slew after power is applied or if the motor quits or stalls, verify that there are no physical obstructions that would impede telescope movement.
- If all physical obstacles are removed and the telescope still does not move properly, turn off the power and unplug the Electronic Controller. Plug the Electronic Controller back in and turn the power back on.

Unable to see an image through the eyepiece:

- Confirm that the lens cover has been removed from the telescope.
- Confirm that the flip-mirror control (16, Fig. 1) is in the "up" position if using the eyepiece holder (4, Fig. 1) so that light is directed to the eyepiece (1, Fig. 1). Confirm that the flip-mirror control is in the "down" position if using the #932 Erecting Prism or doing photography with the ETX-90EC (see Telescope Controls andPHOTOGRAPHY WITH THE ETX-90EC).

Object appears in the viewfinder but not in the eyepiece:

- The viewfinder is not properly aligned with the telescope (see THE VIEWFINDER).

Slew speed does not change when the SPEED key is pressed or the telescope moves slowly even though the fast slew speed is chosen:

- Verify that only one light is lit on the Electronic Controller. If more than one light is on or blinking then the Mode function is active. Exit the Mode function by pressing and holding the MODE key until only one light is on (seeElectronic Controller Modes).
- The battery power may be low (see Assembly Instructions.)

Telescope does not track a celestial object:

- The telescope can only track celestial objects automatically if it is properly polar aligned and the motor drive has been activated (see Polar Alignment Procedure and Modes of Operation).

Images through the eyepiece appear unfocused or distorted:

- The magnification used may be too high for the seeing conditions. Back off to a lower power eyepiece (seeUnderstanding Magnification).
- If inside a warm house or building, move outside. Interior air conditions may distort terrestrial or celestial images, making it difficult, if not impossible, to obtain a sharp focus. For optimal viewing, use the telescope outside in the open air instead of observing through an open or closed window or screen.
- If viewing a land object on a warm day, heat waves will distort the image (see Terrestrial Observing).
- For clear viewing of objects, turn the focus knob (9, Fig. 1) slowly since the "in-focus" point of a telescope is precise. Turning the focus knob too quickly may cause the focus point to pass without notice.
- The optics within the telescope need time to adjust to the outside ambient temperature to provide the sharpest image. To "cool down" the optics, set the telescope outside for 10 to 15 minutes before observing begins.

Telescope moves off a terrestrial object while observing:

- The motor drive may be activated (see Modes of Operation).
- Verify that the vertical and horizontal locks are tight (see Telescope Controls).

Telescope does not move past a certain point:

- The built-in vertical or horizontal rotational "stops" may have been reached (see Rotational Limits).

Telescope pauses when changing slew direction:

- This pause is normal (see Arrow Keys).

A terrestrial object appears reversed left-for-right:

- An eyepiece in the standard 90° observing position (4, Fig. 1) yields this image orientation. To view a correctly oriented image, the optional #932 Erecting Prism is required (see OPTIONAL ACCESSORIES.

Meade Customer Service

If you have a question concerning the ETX-90EC, call the Meade Instruments Customer Service Department at (949) 451-1450, or fax at (949) 451-1460. Customer Service hours are 8:30 AM to 4:30 PM, Pacific Time, Monday through Friday. In the unlikely event that the ETX-90EC requires factory servicing or repairs, **write or call the**

Meade Customer Service Department first, before returning the telescope to the factory, giving full particulars as to the nature of the problem, as well as your name, address, and daytime telephone number. The great majority of servicing issues can be resolved by telephone, avoiding return of the telescope to the factory.

Specifications: ETX-90EC Telescope

Optical design	Maksutov-Cassegrain
Primary mirror diameter	96mm (3.78")
Clear aperture	90mm (3.5")
Focal length	1250mm
Focal ratio (photographic speed)	f/13.8
Near focus (approx)	11.5 ft (3.5m)
Resolving power	1.3 arc secs
Super multi-coatings	standard
Limiting visual stellar magnitude (approx)	11.7
Image scale	1.16°/inch
Maximum practical visual power	325X
Optical tube dimensions (dia. x length)	10.4cm x 27.9cm (4.1" x 11")
Secondary mirror obstruction (dia.; %)	27.9mm (1.1"); 9.6%
Telescope mounting	fork type; double tine
Setting circle diameters	Dec: 3.5"; RA: 7"
Input voltage	12-volts DC
Hemispheres of operation	north and south, switchable
Electronic controller	4 speed, both axes
Bearings:	
Altitude	UHMW Polyethylene
Azimuth	PTFE
Materials:	
Tube body	aluminum
Mounting	high-impact ABS, aluminum-reinforced
Primary mirror	Pyrex® glass
Correcting lens	BK7 optical glass, Grade-A
Telescope dimensions	38cm x 18cm x 22cm (15" x 7" x 9")
Telescope net weight: (incl. Electronic Controller & batteries)	3.5kg (7.8 lbs)
Telescope shipping weight	5.6kg (12.3 lbs)

PRECISE POLAR ALIGNMENT; SETTING CIRCLES

WARNING! Never use the Meade ETX-90EC Astro Telescope to look at the Sun! Looking at or near the Sun will cause *instant* and *irreversible* damage to your eye. Eye damage is often painless, so there is no warning to the observer that damage has occurred until it is too late. Do not point the telescope or its viewfinder at or near the Sun. Do not look through the telescope or its viewfinder as it is moving. Children should always have adult supervision while observing.

Precise Polar Alignment

Important note: *For almost all astronomical observing requirements approximate settings of the telescope's latitude and polar axis are acceptable! Do not allow undue attention to precise polar alignment of the telescope to interfere with your basic enjoyment of the instrument.*

If desired, more precise polar alignment may be obtained by first accomplishing basic polar alignment as detailed in Polar Alignment Procedure, then returning to this procedure:

NOTE: This procedure moves the telescope physically to precisely line up with the celestial pole. Do not use the Electronic Controller arrow keys to move the telescope electronically or polar alignment will be lost.

1. Orient the entire telescope, including tripod or tripod legs, so that the polar axis is pointing toward Polaris (Fig. 15).
2. While observing through the SP 26mm eyepiece of the telescope, adjust the length of the adjustable tripod leg until Polaris is visible in the eyepiece. Use a combination of (a) *lifting and turning the entire telescope* (or nudging the position of one of the fixed tripod legs) and (b) *adjusting the length of the adjustable tripod leg to place Polaris in the center of the telescope's field.*
3. Repeat step 2 of this procedure in about 15 minutes to see how much drift has taken place and to make the alignment more precise.

Although the above procedure is somewhat tedious (since the field of view of the telescope with the SP 26mm eyepiece is only about 1°), it is a worthwhile effort if precise polar alignment is desired (e.g., if photography of the Moon or a planet is to be performed). With Polaris placed in the center of the telescope's eyepiece, the telescope is now polar aligned within about one or two degrees - a level of alignment precision more than sufficient for almost any observing application.

To provide the most stable platform from which to polar align the ETX-90EC it is recommended to purchase the #883 Deluxe Field Tripod. The tripod head tilts easily to the local latitude angle for quick polar alignment, and locks in a 90° position to facilitate Alt/Az viewing (see OPTIONAL ACCESSORIES).

Setting Circles

The ETX-90EC is equipped with R.A. and Dec Setting Circles (14 and 18, Fig. 1) to aid in locating faint celestial objects *when the telescope has been polar aligned.* Setting circles emulate the celestial coordinates found on star charts or in sky catalogs. Any charted object is easily located by coordinates in R.A. (in hours, minutes, and seconds, from 0h 0m 0s to 23h 59m 59s and Dec (in degrees from 0° to ±90°).

With the ETX-90EC polar aligned the Electronic Controller arrow keys (1, Fig. 5) are used to move the telescope in Right Ascension (left and right keys) and Declination (up and down keys).

NOTE: The Dec setting circle is located on the left arm of the telescope fork mount. The right arm of the mount contains a graduated circle (mounted behind the knurled knob of the vertical lock), without Declination numbers.

- **Right Ascension Setting Circle:** Since celestial objects move in Right Ascension the R.A. setting circle (Fig. 36) must be reset as each object is located during an observing session. The R.A. pointer is located on the drive base 90° counterclockwise from the telescope's computer control panel (11, Fig. 1) immediately under the R.A. circle.

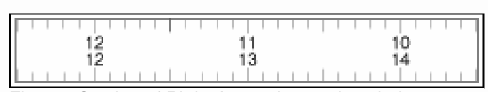


Fig. 36: Section of Right Ascension setting circle.

NOTE: The R.A. circle has two rows of numbers from 0 to 23, corresponding to the hours of a 24-hour clock. The upper row of numbers is used by observers in the Earth's northern hemisphere, the lower row by observers in the Earth's southern hemisphere.

- **Declination Setting Circle:** The Dec setting circle (Fig. 37) has been factory set to read the correct Declination of sky objects. Since the smooth knob on this fork mount arm need never be loosened, the Dec setting circle should always remain calibrated.

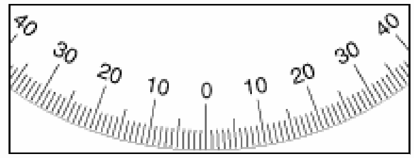


Fig. 37: Section of Declination setting circle.

  If for some reason this knob becomes loose and the Dec setting circle must be recalibrated, level the optical tube (5, Fig. 1) so that it is parallel to the drive base. Loosen the smooth knob covering the Dec setting circle until the setting circle moves freely. Reposition the setting circle so that the "0" setting is lined up with the Dec pointer (5, Fig. 15). Retighten the Dec knob.

To use the setting circles to find astronomical objects, the ETX-90EC must first be polar aligned; it is advisable that the motor drive be turned on (see Modes of Operation, page 11) and that a low-power eyepiece (e.g., the SP 26mm eyepiece) be employed. Then follow this procedure:

1. Identify the celestial coordinates (R.A. and Dec) of a bright, easy-to-find object, such as a bright star. (Avoid using Polaris or any object near Polaris.) Coordinates of some bright stars are listed in the Star Locator (page 22), or use a star chart. Center this object in the telescope's field of view.
2. Manually turn the R.A. circle (14, Fig. 1) to read the R.A. of the object at the R.A. pointer (7, Fig. 15).
3. The R.A. circle is now calibrated to read the correct R.A. of any object at which the telescope is pointed. The Dec circle is already calibrated through polar alignment.
4. To find another object, again identify the R.A. and Dec coordinates. Then, *without touching the setting circles*, move the telescope (manually, by unlocking the vertical and horizontal locks, or by slewing the telescope using the Electronic Controller arrow keys) so that the R.A. and Dec pointers read the coordinates of the second object.
5. If the above procedure has been followed carefully, the second object will now be in the telescope's field of view.

NOTE: Since the second object (i.e., the object to be located) is in constant motion, once the R.A. circle is calibrated (step 2 above) the telescope should be moved rapidly to read the coordinates of the second object. Otherwise the second object will no longer be in the position indicated by the R.A. circle.

Using setting circles requires a developed technique. When using the circles for the first time, try hopping from one bright star (the calibration star) to another bright star of known coordinates. Practice moving the telescope from one easy-to-find object to another. In this way the precision required for accurate object location becomes evident.

ROADMAP TO THE STARS

WARNING! Never use the Meade ETX-90EC Astro Telescope to look at the Sun! Looking at or near the Sun will cause *instant* and *irreversible* damage to your eye. Eye damage is often painless, so there is no warning to the observer that damage has occurred until it is too late. Do not point the telescope or its viewfinder at or near the Sun. Do not look through the telescope or its viewfinder as it is moving. Children should always have adult supervision while observing.

The night sky is filled with wonder and intrigue. You too, can enjoy exploring the universe simply by following a few pointers on a *roadmap* to the stars.

First, find the **Big Dipper** which is part of the constellation Ursa Major. The Big Dipper is usually easy to locate year round in North America due to its proximity to the North Star, Polaris.

Extending directly out from the far side of the Big Dipper's cup is the constellation Orion. One of the most exquisite areas of the winter sky, **Orion** is distinguished by two bright stars, Rigel and Betelgeuse, and Orion's belt which is marked by three stars in a row. The **Orion Nebula** is located south of the belt and is one of the most observed deep-sky objects by amateur astronomers.

Extending from the "pointer stars" - or end stars - of the Big Dipper's cup is Polaris, the closest star to the northernmost point of the celestial sphere. Extending from Polaris is the **Great Square** shared by the constellation Pegasus and Andromeda. Within Andromeda is the Andromeda Galaxy, the closest large galaxy to our solar system at about 2.2 million light-years away.

The **Summer Triangle** is a notable region in the sky to the left of the handle of the Big Dipper. The triangle is made up of three very bright stars: Vega, Deneb and Altair.

By drawing an imaginary line outward from the handle of the Big Dipper you reach the southern constellation **"Scorpius."** Scorpius curves to the left like the tail of a scorpion in the sky, or like letter "J."

Amateur astronomers commonly use the phrase ***"Arc to Arcturus and spike to Spica"*** to refer to the area directly off the arc in the handle of the Big Dipper. Follow the *arc to Arcturus*, the second brightest star in the Northern Hemisphere, then *spike down to Spica*, the 16th brightest star in the sky. Now follow the arc in the handle of the Big Dipper in the opposite direction and you reach another famous arc called **The Sickle**, in the constellation **Leo.**

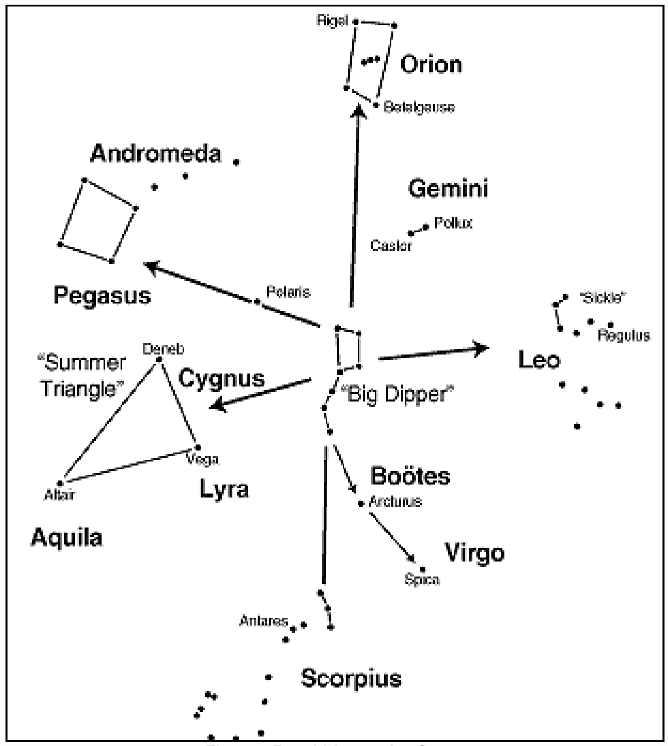


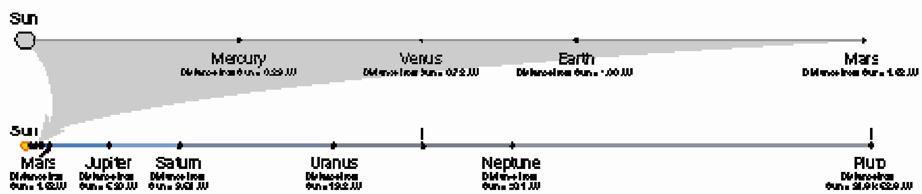
Fig. 38: Road Map to the Stars.

YOU AND THE UNIVERSE

Distance from the Earth to the Moon

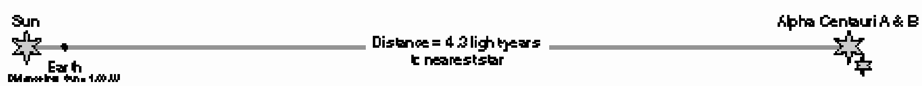
Distance between planets

Distance of the Earth to the Sun is 93 million miles or 1 Astronomical Unit (AU)



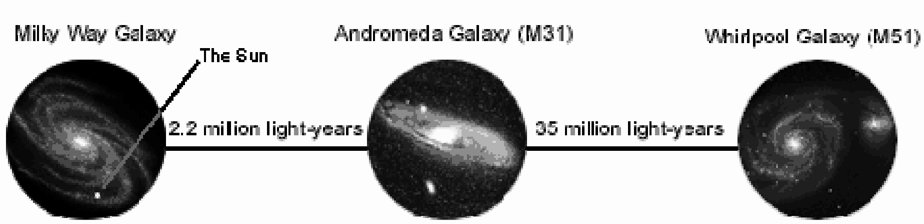
Distance between stars

Distance from the Sun to the nearest star is about 4.3 light years, or 25 trillion miles. This distance is so large that if a scale model were created with the Earth one inch away from the Sun, the nearest star would have to be placed over 4 miles away!



Approximately one hundred billion stars, including the Sun, comprise the Milky Way Galaxy, which is a spiral-shaped collection of stars believed to be more than 100,000 light years in diameter.

Distance between galaxies



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