Instruction Manual

ETX-70EC Astro Telescope with Electronic Controller

Meade Instruments Corporation

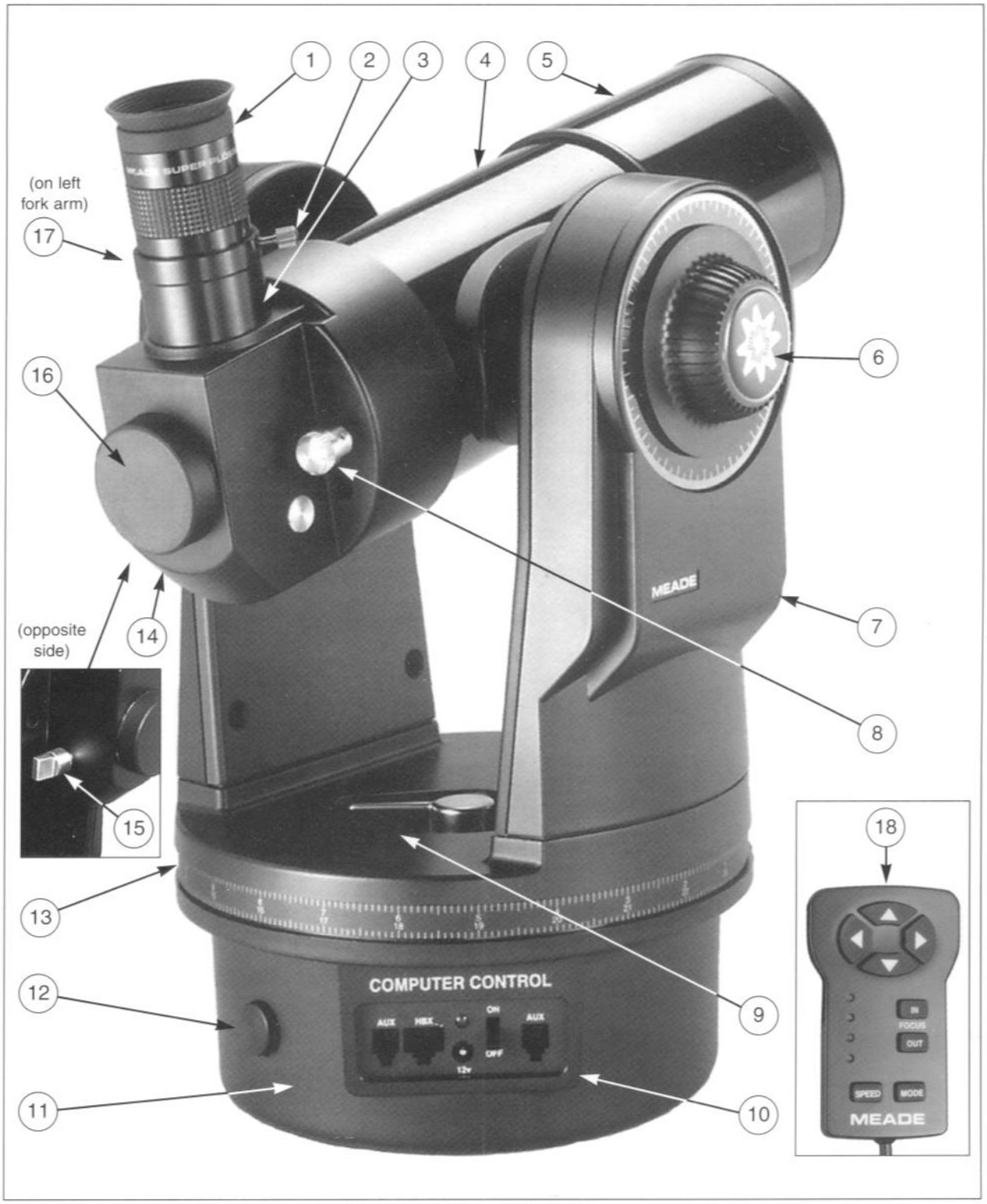


Fig. 1: The ETX-70EC Astro Telescope.

Captions for Figure 1

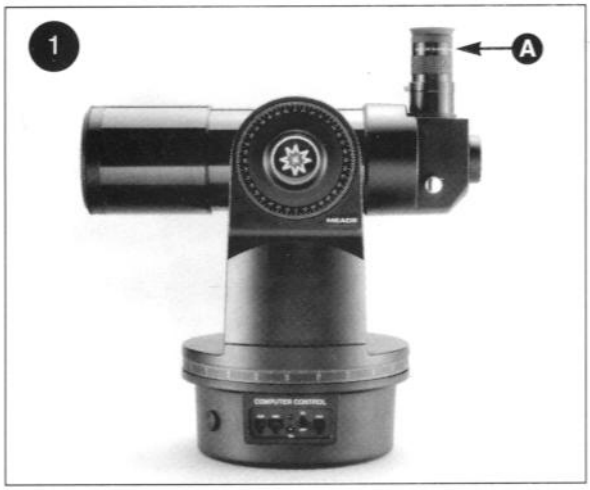
1. Eyepiece
2. Eyepiece Holder Thumbscrew
3. 90° Eyepiece Holder
4. Optical Tube
5. Movable Objective Lens Cell
6. Vertical (or Declination) Lock
7. Fork Arm
8. Focus Knob
9. Horizontal (or Right Ascension) Lock
10. Computer Control Panel
11. Drive Base
12. Hole Cover for Optional Tripod Legs (2)
13. Right Ascension (R.A.) Setting Circle
14. Cellback containing Flip-Mirror
15. Flip-Mirror Control Knob
16. Photo Port
17. Declination (Dec) Setting Circle (on left fork arm)
18. Electronic Controller with attached Coil Cord

WARNING!

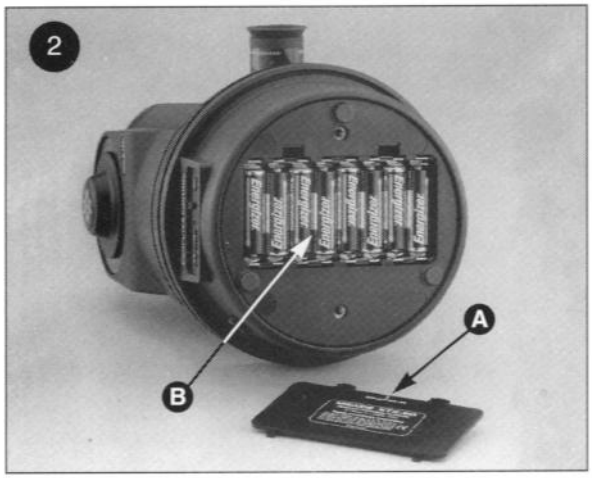
Never use a Meade® ETX® Astro Telescope to look at the Sun! Looking at or near the Sun will cause *instant* and *irreversible* damage to your eye. Eye damage is often painless, so there is no warning to the observer that damage has occurred until it is too late. Do not point the telescope or its viewfinder 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.

CAUTION: Use care to install batteries as indicated by the battery compartment. Follow battery manufacturers precautions. Do not install batteries backward or mix new and used batteries. Do not mix battery types. If these precautions are not followed, batteries may explode, catch fire, or leak. Improperly installed batteries void your Meade warranty.

If you are anxious to use your ETX-70EC Astro Telescope for the first time, before a thorough reading of this instruction manual, see the Quick-Start Guide on page 4.



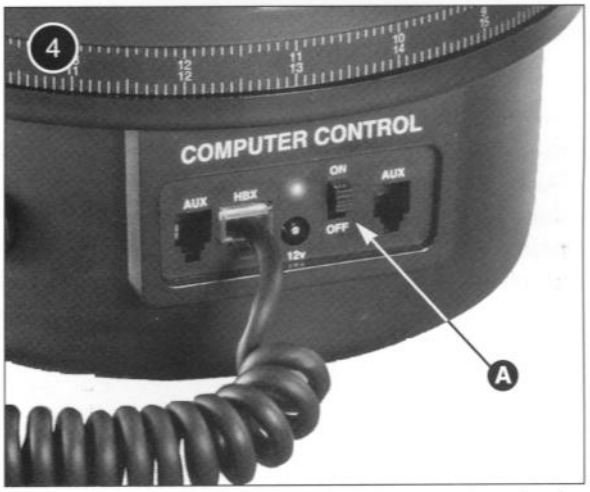
Remove the ETX from its packaging and place it on a sturdy surface. Place the eyepiece (A) into the eyepiece holder on the telescope and tighten the attachment thumbscrew to a firm feel only.



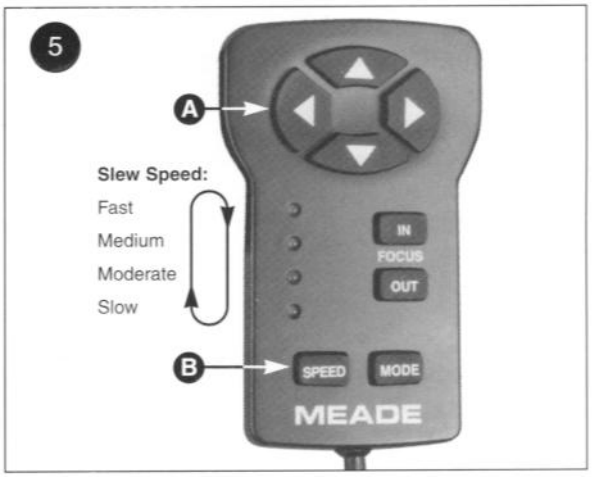
Securely place the ETX on its side and remove the battery compartment cover (A) from the underside of the drive base. Insert eight AA-size (user-supplied) batteries into the battery compartment (B) in the proper orientation. Replace the cover and return the telescope to an upright position.

*NOTE: The telescope has rotational hard stops in the horizontal and vertical axes to prevent damage to the telescope. See **Quick Tips**, page 6, for more information.*

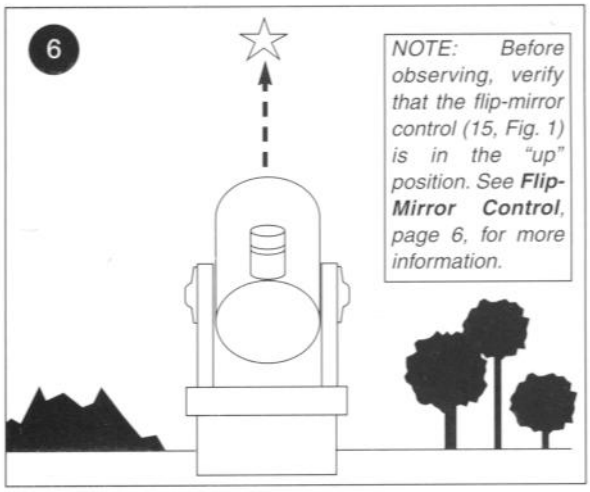
Verify that the computer control panel power switch is in the OFF position. Remove the Electronic Controller (18, Fig. 1) from the packing materials and plug it into the HBX port (A). Tighten the vertical and horizontal locks (6 and 9, Fig. 1), then remove the dust cover from the end of the telescope tube.



Flip the Power Switch (A) on the computer control panel to the ON position. The lights flicker on the Electronic Controller. Press any key and the motors briefly move the telescope. The Electronic Controller is now operational.



Use the arrow keys (A) of the Electronic Controller to slew (move) the telescope up and down and/or left and right. To change the telescope's slew speed, press the SPEED key (B). The indicator lights signify the slew speed with the upper light showing the highest speed. Each press slows the slew speed down one level then cycles back to the highest speed.



*NOTE: Before observing, verify that the flip-mirror control (15, Fig. 1) is in the "up" position. See **Flip-Mirror Control**, page 6, for more information.*

Sight along the side of the telescope's main tube to locate an object. Practice using the arrow keys on the Electronic Controller to center an object in the telescope's field of view. Use the telescope's focus knob (8, Fig. 1) to bring the object into focus.

CHAPTER 1

INTRODUCTION

The Meade ETX-70EC Astro Telescope is an extremely versatile, high-resolution imaging system that, with advanced features similar to larger and more specialized telescopes, can be used by casual observers and serious astronomers alike. With pushbutton controls, automatic tracking of celestial objects (with one of the optional tripods), and diffraction-limited imaging, an ETX-70EC telescope may be all the telescope ever required by many terrestrial and astronomical observers.

As a first telescope the ETX-70EC reveals nature in an ever-expanding level of detail: observe the feather structure of a bird from 50 yards or study the rings of the planet Saturn from a distance of 800 million miles. Beyond the Solar System observe nebulae, star clusters, galaxies, and other deep-sky objects. The Meade ETX-70EC is an instrument fully capable of growing with your interest.

You should read this manual thoroughly so that full advantage can be taken of the telescope's numerous advanced features.

The Electronic Controller

Control of the ETX-70EC telescope is through pushbutton operation of the standard-equipment Electronic Controller (Fig. 2). Nearly all functions of the telescope are accomplished through the Electronic Controller with just a few button pushes:

- Move the telescope on two axes (up-and-down or left-to-right) at any of 4 drive speeds for precise tracking of astronomical or terrestrial objects.
- Mount the telescope in the "polar" mode for fully automatic tracking of celestial objects using the optional #880 Table Tripod, or #883 Deluxe Field Tripod (see **OPTIONAL ACCESSORIES**, pages 15 and 16).
- When in the polar mode, switch the motor drive between northern and southern hemisphere operation for observing from anywhere in the world.

Fig. 2: Electronic Controller.

A detailed description of the functions and operation of the Electronic Controller is found in **Electronic Controller Functions**, page 6.

Parts Listing

In keeping with the ETX philosophy of elegant simplicity, the ETX-70EC telescope is virtually completely assembled at the Meade factory; getting the telescope ready for first observations requires only a few minutes. When first opening the packing box, note carefully the following parts:

- The ETX-70EC Astro Telescope with fork mount system.
- Electronic Controller with attached coil cord.
- Super Plössl (SP) 20mm eyepiece and MA 9mm eyepiece, each packed in a plastic storage container.
- 2X Barlow Lens, packed in a separate small box.
- Hex-wrench, packed with the instruction manual.

Assembly Instructions

Assembly of the ETX-70EC telescope requires eight AA-size (user-supplied) batteries and only three steps:

1. Remove the SP 20mm eyepiece (1, Fig. 1) from its container and place it in the eyepiece holder (3, Fig. 1). Tighten the thumbscrew (2, Fig. 1) to a *firm feel* only.
2. The telescope's battery compartment (6, Fig. 3) is located at the bottom of the drive base. Place the telescope securely on its side as shown in Fig. 3. Open the battery compartment by simultaneously depressing the two release latches (4, Fig. 3) and pulling the battery cover (5, Fig. 3) away from the drive base. Insert eight AA-size batteries into the battery compartment, oriented as shown on the battery mounting board. Replace the cover.

CAUTION: Use care to install batteries as indicated by the battery compartment. Follow battery manufacturers precautions. Do not install batteries backward or mix new and used batteries. Do not mix battery types. If these precautions are not followed, batteries may explode, catch fire, or leak. Improperly installed batteries void your Meade warranty.

3. Place the telescope in an upright position on a flat surface. Be certain that the power switch on the computer control panel (1, Fig. 4) is in the OFF position. Plug the coil cord for the Electronic Controller into the HBX port (3, Fig. 4).

Basic assembly of the ETX-70EC is now complete.

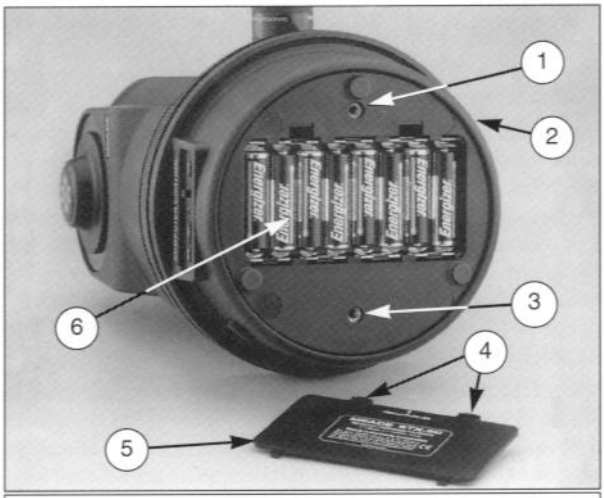


Fig. 3: Bottom view of the ETX-70EC showing eight AA-size batteries mounted inside the battery compartment. (1) High-Latitude Tripod Leg Hole; (2) Drive Base; (3) Alternate Tripod Leg Hole; (4) Release Latches; (5) Battery Compartment Cover; (6) Battery Compartment.

CHAPTER 1

TELESCOPE FEATURES

Quick Tips

- **Rotational Limits:** The telescope base and fork mount are designed with internal "rotational limit stops." The *horizontal limit stop* prevents the telescope from rotating more than 630° to avoid damage to the internal wiring. The *vertical limit stop* prevents the viewfinder from contacting the fork mount when the telescope is pointed upward just past 90° and prevents the optical tube from contacting the base if pointed downward more than 30°. *Do not force the telescope to move beyond these stops or damage to the telescope will result.*
- **Vertical Lock; Declination Setting Circle:** The vertical lock knob (6, Fig. 1) is a knurled knob located on the fork arm to the right of the focus knob (8, Fig. 1). Mounted beneath the knob is a circular scale with no numbers. Do not confuse this scale with the Dec setting circle (17, Fig. 1) on the opposite fork arm which has a number scale used to locate astronomical objects.
- **A Note on Indoor Viewing:** While casual, low-power observations may be made with the telescope through an open or closed window, the best observing is always done outdoors. Temperature differences between inside and outside air and/or the low quality of most home window glass can cause blurred images through the telescope. *Do not expect high-resolution imaging under these conditions.*

Telescope Controls

An important array of features and manual controls facilitates operation of the ETX-70EC. *Be sure to become acquainted with all of these controls before attempting observations through the telescope.*

Horizontal Lock (9, Fig. 1): Controls manual horizontal rotation of the telescope while sitting upright as shown in Fig. 1. Turning the horizontal lock *counterclockwise* unlocks the telescope, enabling it to be freely rotated by hand about the horizontal axis. Turning the horizontal lock *clockwise* prevents the telescope from being rotated manually, but engages the horizontal motor drive clutch for Electronic Controller operation. When polar aligned, the horizontal lock serves as the Right Ascension, or R.A. lock (see **Right Ascension**, page 11).

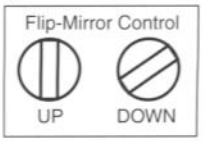
Vertical Lock (6, Fig. 1): Controls manual vertical movement of the telescope while sitting upright as shown in Fig. 1. Turning the vertical lock *counterclockwise* unlocks the telescope enabling it to be freely rotated by hand about the vertical axis. Turning the vertical lock *clockwise (to a firm feel only)* prevents the telescope from being moved manually, but engages the vertical motor drive clutch for Electronic Controller operation. When polar aligned, the vertical lock serves as the Declination, or Dec lock (see **Declination**, page 11).

CAUTION: When loosening the vertical lock, be sure to support the objective lens cell (5, Fig. 1). The weight of the objective lens could cause the tube to swing downward suddenly and misalign the optics.

Focus Knob (8, Fig. 1): Causes a finely-controlled motion of the telescope's objective lens to achieve precise image focus. The ETX-70EC can be focused on objects from a distance of about 17 ft to infinity. Rotate the focus knob *clockwise* to focus on distant objects; *counterclockwise* to focus on near objects.

Flip-Mirror Control (15, Fig. 1): The ETX-70EC includes an internal optically-flat mirror. With the flip-mirror control in the "up" position, as shown in Fig. 1, light is diverted at a 90° angle to the eyepiece. Alternately, with the flip-mirror control in the "down" position, light proceeds straight through the telescope and out the photo port (16, Fig. 1) for telephoto or astronomical photography using the optional #64ST T-Adapter, or for observing with the optional #933 45° Erecting Prism (see **OPTIONAL ACCESSORIES**, page 16).

NOTE: The flip-mirror control is in the "up" position when the control is vertical (perpendicular to the telescope tube). To place the flip-mirror in the "down" position, turn the control approximately 125° clockwise until it stops.



Computer Control Panel

The computer control panel (Fig. 4) of the ETX-70EC includes a connector for either the standard-equipment Electronic Controller or the optional #495 Autostar Computer Controller, an external power supply connector, and two auxiliary ports (see **OPTIONAL ACCESSORIES**, page 15).

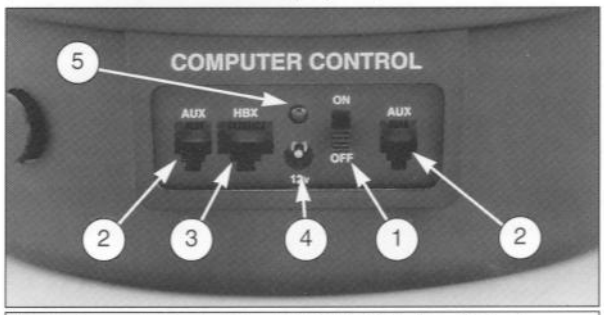


Fig. 4: Computer Control Panel. (1) ON/OFF Switch; (2) Auxiliary Ports; (3) Handbox Port; (4) 12v Connector; (5) Power Indicator Light.

ON/OFF (1, Fig. 4): When the ON/OFF switch is moved to the ON position, the red power indicator light (5, Fig. 4) illuminates and power is supplied to the Electronic Controller and to the telescope's motor drive.

AUX (2, Fig. 4): Two identical auxiliary ports provide connections for current and future Meade accessories.

CAUTION: Using products other than standard Meade accessories may cause damage to the telescope's internal electronics and may void the Meade warranty.

HBX (3, Fig. 4): The HBX (handbox) port is designed to accept the plug from the coil cord of the Electronic Controller or the optional #495 Autostar Computer Controller.

12v (4, Fig. 4): The 12v connector is designed to accept an external power supply such as the optional #541 AC adapter or the #607 Power Cord (see **OPTIONAL ACCESSORIES**, page 16). When one of these alternate powering options is used, the internal batteries are disconnected from the power circuit.

NOTE: Always remove the batteries if they are not to be used for a long period of time.

Electronic Controller Functions

The Electronic Controller provides the observer with the means to control the telescope motors from a compact handbox. The Electronic Controller (Fig. 5) has soft-touch keys designed to have a positive feel, even through gloves.

Primary function of the Electronic Controller is to move (slew) the telescope and indicate the slew speed. Other functions are also possible when using the MODE key (see **Electronic Controller Modes**, page 10 and **APPENDIX A**, page 19).

Arrow Keys (1, Fig. 5): The four arrow keys slew the telescope in four directions (i.e., up-and-down or left-to-right) at any one of four slew speeds (see **SPEED Key**, page 7).

***Important Note:** While using the arrow keys to slew to an object, when reversing direction there may be a slight pause as the telescope motors compensate for the reversal of the internal gears.*

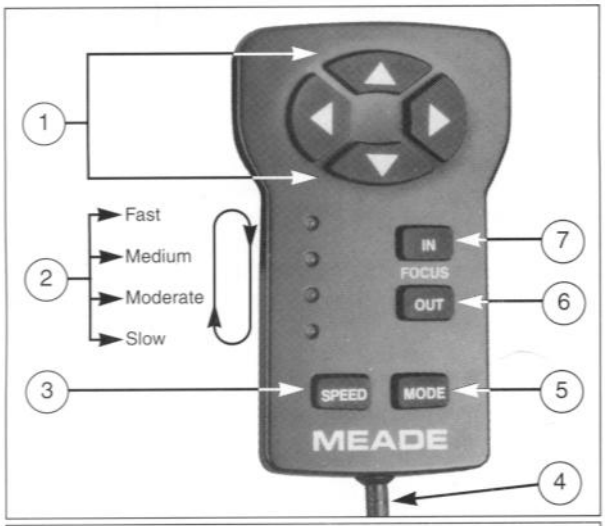


Fig. 5: Electronic Controller. (1) Arrow Keys; (2) Indicator Lights; (3) SPEED Key; (4) Coil Cord; (5) MODE Key; (6) OUT Key; (7) IN Key.

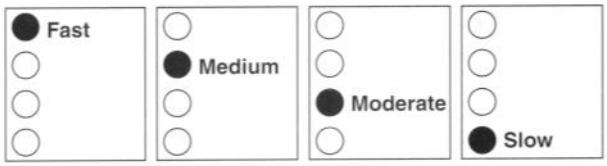
Indicator Lights (2, Fig. 5): Four red LED (Light Emitting Diode) lights are used to indicate the current slew speed.

NOTE: For purposes of this manual, the lights are identified as 1 through 4, with 1 being the top light and 4 the bottom light.

Indicator Light Key
The procedures in this manual identify the status of the four indicator lights in a box to the left of the appropriate step. They are depicted as *On*, *Blinking* or *Off*, depending on the mode at that point.

Light No.	Light Status
Light 1	On
Light 2	Blinking
Light 3	Off
Light 4	

SPEED Key (3, Fig. 5): The SPEED key is used to change the speed at which the telescope slews when the arrow keys are pressed. Each press of the SPEED key changes the slew speed to the next slower setting. If already on the slowest slew speed (Light 4), pressing the SPEED key cycles back to the highest speed (Light 1). Slew speeds are signified by the indicator lights (2, Fig. 5).



MODE Key (5, Fig. 5): Pressing and holding the MODE key puts the Electronic Controller into the Mode function (see **Electronic Controller Modes**, page 11).

OUT Key (6, Fig. 5): The OUT key is used to decrease the speed of the tracking motor (see **APPENDIX A**, page 19).

IN Key (7, Fig. 5): The IN key is used to increase the speed of the tracking motor (see **APPENDIX A**, page 19).

First Observations

Unthread the dust cap from the front lens of the telescope *(counterclockwise)*, and the ETX-70EC may now be used for terrestrial (land) observing.

NOTE: The dust cap should be replaced after each observing session and the power turned off to the telescope. Verify that any dew that might have collected during the observing session has evaporated prior to replacing the dust cap.

The ETX-70EC includes two standard-equipment eyepieces, as well as a 2X Barlow lens. When each eyepiece is inserted in the eyepiece holder, the telescope is operating at the following powers (see **Understanding Magnification**, page 8):

Eyepiece	Power	2X Barlow
SP 20mm	17.5X	35X
MA 9mm	39X	78X

Objects viewed through the eyepiece are correctly oriented up-and-down in the telescope but are reversed left-for-right. Image orientation is discussed further in **Terrestrial Observing**, page 9. The flip-mirror control (15, Fig. 1) must be in the "up" position in order to observe an image through the telescope's eyepiece (see **Flip-Mirror Control**, page 6).

For the ultimate viewing experience it is important to become familiar with the features of the ETX-70EC and the functions of the Electronic Controller. Upon completing this chapter make first observations of a simple land object several hundred yards in the distance — perhaps a telephone pole or a building. Practice focusing on the object using the focus knob (8, Fig. 1) and centering the object in the eyepiece using the Electronic Controller arrows keys (1, Fig. 5).

Observing with the Electronic Controller

With the Electronic Controller in the factory pre-set "Alt/Az" (vertical-horizontal) mode, the Electronic Controller arrow keys permit pushbutton movements (slewing) of the telescope. To move the telescope using the Electronic Controller:

1. Set the telescope on a level and stable surface, or mount to the Meade #883 Deluxe Field Tripod (see **OPTIONAL ACCESSORIES**, page 16).
2. Insert a low-power eyepiece (e.g., SP 20mm) into the eyepiece holder (3, Fig. 1) and tighten the eyepiece thumbscrew (2, Fig. 1).
3. Tighten the vertical and horizontal locks (6 and 9, Fig. 1).
4. Verify that the power switch (1, Fig. 4) on the telescope's computer control panel is OFF.
5. Plug in the Electronic Controller coil cord (4, Fig. 4) to the HBX port (3, Fig. 4) on the computer control panel.

6. Flip the power switch to ON. The power indicator light (5, Fig. 4) on the computer control panel comes on and all four Electronic Controller indicator lights (2, Fig. 5) blink rapidly.
7. Press any key on the Electronic Controller and the telescope slews momentarily in the vertical and horizontal directions to test the motors.

8. When the test is complete, Light 1 comes on steady; Lights 2, 3, and 4 turn off.
9. Use the four arrow keys (1, Fig. 5) to slew the telescope to the desired object. To change the slew speed, press the SPEED key.
10. Fine-adjust the position of the object with the Electronic Controller arrow keys so that it is centered in the viewfinder. The object is now ready to be viewed through the telescope's eyepiece.

Observing Tip: *If the Electronic Controller has previously been placed in the polar mode (see **Electronic Controller Modes**, page 10) and Alt/Az operation is desired, flip the telescope power switch to OFF and perform steps 6, 7, and 8 above. The telescope is now in the Alt/Az mode. This procedure does not work if one of the mode screws has been removed (see **Using the Mode Screws**, page 10).*

CHAPTER 2

INTRODUCTION

The ETX-70EC can be used for immediate observation right out of the box. However, becoming familiar with the fundamentals of a telescope makes subsequent viewing easier and more rewarding.

Choosing an Eyepiece

The function of a telescope's eyepiece is to magnify the image formed by the telescope's main optics. Each eyepiece has a focal length (expressed in millimeters, or "mm"). The smaller the focal length, the higher the magnification. Low power eyepieces offer a wide field of view, bright high-contrast images, and eye relief during long observing sessions. To find an object with a telescope it is always best to start with a low power eyepiece such as the SP 20mm supplied with the ETX–70EC. When the object is located and centered in the eyepiece, switch to a higher power eyepiece to enlarge the image as much as practical for prevailing seeing conditions.

Lower power eyepieces are recommended for terrestrial viewing. Haze, heat waves, and particulate matter in the air distort images when using higher powers.

For astronomical observing a selection of several different eyepieces is recommended. For general observing of the Moon and planets, low to medium powers are preferred. For deep-sky objects such as nebulae and galaxies, higher powers may be needed for the best view if conditions permit.

NOTE: Seeing conditions vary widely from night-to-night. Turbulence in the air, even on an apparently clear night, can distort images. If an image appears fuzzy and ill-defined, back off to a lower power eyepiece for a more well-resolved image (see Fig. 6).

Understanding Magnification

The magnification, or power, at which a telescope is operating is determined by two factors: the *focal length of the telescope* and the *focal length of the eyepiece employed.*

Telescope Focal Length is the distance that light travels inside the telescope before reaching a focus. The focal length of the ETX-70EC is 350mm, or about 13.8".

Eyepiece Focal Length is the distance light travels inside the eyepiece before reaching focus. Focal length is usually printed on the side of the eyepiece. The ETX-70EC is supplied with two eyepieces as standard-equipment. The Super Plössl (SP) 20mm eyepiece has a focal length of 20mm, while the Modified Achromatic (MA) 9mm eyepiece has a focal length of 9mm. "Super Plössl" and "Modified Achromatic" refers to the optical design of the eyepiece. The SP 20mm eyepiece is a design specifically intended for high-performance telescopes and one which yields a wide, comfortable field of view with extremely high image resolution. The MA 9mm eyepiece provides a smaller field of view but a higher magnification for use when seeing conditions permit.

Calculating Magnification: On a telescope, such as the ETX–70EC, different eyepiece focal lengths are used to achieve different magnifications, from low to high. The standard-equipment SP 20mm eyepiece yields 17.5X ("17.5–power") and the MA 9mm yields 39X. The standard-equipment Barlow lens doubles the power of the eyepiece employed. A variety of powers are obtainable with the addition of optional eyepieces (see **OPTIONAL ACCESSORIES**, page 15).

Use this formula to calculate the magnification obtained with a given eyepiece:

$$\text{Power} = \frac{\text{Telescope Focal Length}}{\text{Eyepiece Focal Length}}$$

Example: The power obtained with the ETX-70EC using the SP 20mm eyepiece is:

$$\text{Power} = \frac{350\text{mm}}{20\text{mm}} = 17.5\text{X}$$

Too Much Power: The most common mistake of the beginning observer is to "overpower" the telescope by using high magnifications which the telescope's aperture and typical atmospheric conditions can not reasonably support. Keep in mind that a smaller, but bright and well-resolved, image is far superior to one that is larger, but dim and poorly resolved (see Fig. 6). Powers above 110X should be employed only under the steadiest atmospheric conditions.

Most observers should have three or four additional eyepieces to achieve the full range of reasonable magnifications possible with the ETX–70EC.

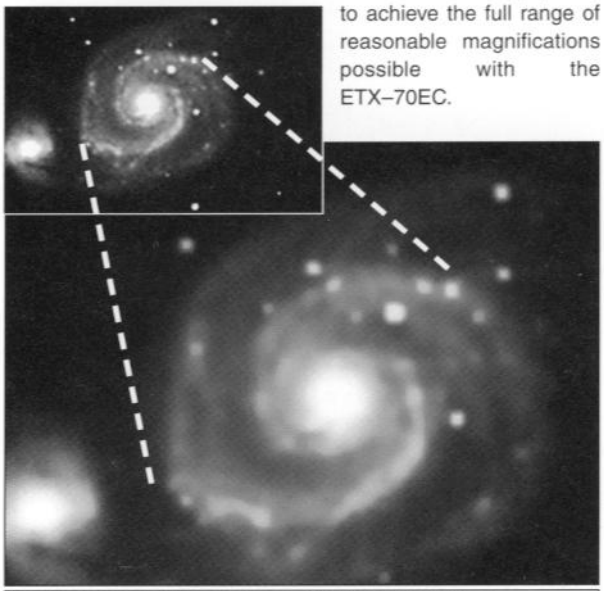


Fig. 6: Example of too much magnification (Galaxy M51).

Telescope Mountings

The mechanical means which causes a telescope's optical tube to move in different directions is called the telescope *mounting*, or *mount*. Telescope mounts are of two basic types:

Altazimuth (Alt//Az) mounts permit motion of the telescope tube in vertical (altitude) and horizontal (azimuth) directions. The ETX-70EC incorporates an altazimuth mount (as shown in Fig. 7). For all terrestrial applications and for casual astronomical observing the telescope operates very well in the altazimuth configuration. The telescope may be placed on a rigid tabletop or the optional Meade #883 Deluxe Field Tripod (see page 16) may be employed to provide a secure, variable-height, altazimuth observing platform. To track objects, either terrestrial or astronomical, with the telescope in the altazimuth configuration, the observer pushes the arrow keys of the Electronic Controller (see page 6).

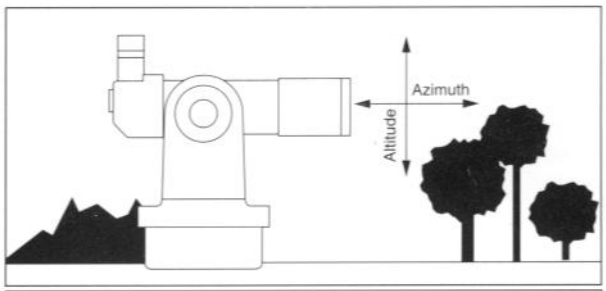


Fig. 7: Alt/Az mounting moves the telescope in vertical and horizontal directions.

CHAPTER 2

Equatorial mounts are highly desirable in the operation of any telescope used for extensive astronomical applications, because celestial objects do not move in vertical or horizontal directions but in a *combination* of these directions. By tilting one of the telescope's mechanical axes (see Fig. 8) to point at the celestial pole (i.e., by pointing one axis of the telescope to the North Star, Polaris), astronomical objects may be followed, or tracked, by turning only *one* axis of the telescope, instead of the simultaneous motions of two axes required of the altazimuth mount. An equatorial mount which has its "polar axis" pointing to the celestial pole is said to be *polar-aligned*. The ETX-70EC can be polar-aligned either by using the optional #880 Table Tripod or the #883 Deluxe Field Tripod (see **OPTIONAL ACCESSORIES**, pages 15 and 16).

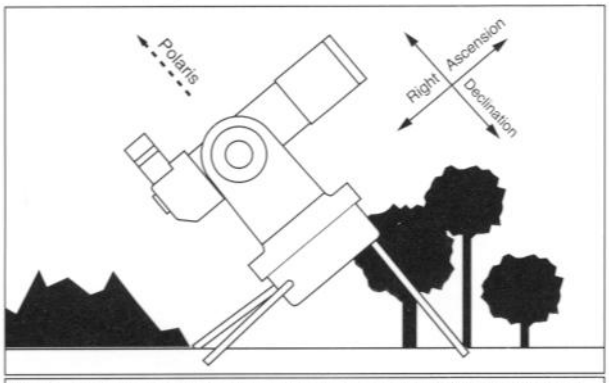


Fig. 8: Equatorial mounting aligns the telescope with the Celestial Sphere.

With the ETX-70EC polar-aligned (see **Polar Alignment Procedure**, page 11) the telescope's internal motor drive may be activated (see **Modes of Operation**, page 10) to enable fully automatic "hands off" tracking of celestial objects; in this configuration the observer does not need to push the arrow keys of the Electronic Controller in order to track celestial objects. Notwithstanding this automatic tracking, the arrow keys of the Electronic Controller are useful in this configuration to enable the centering of objects within the telescopic field or, for example, to rove the telescope over the surface of the Moon or through a large star field.

Terrestrial Observing

The ETX-70EC makes an excellent, high-resolution terrestrial (land), telescope. By setting the telescope on its drive base, as shown in Fig. 1, the telescope may be used for an extremely wide range of observations. Keep in mind, however, that terrestrial images are right-side-up, but reversed left-for-right when viewed through the eyepiece. Normally, such an image orientation is not bothersome, unless trying to read a distant sign, for example. If the telescope is to be used for extensive terrestrial observations, a fully correctly oriented image is provided with the #933 45° Erecting Prism (see **OPTIONAL ACCESSORIES**, page 16).

Viewing terrestrial objects requires looking along the Earth's surface through heat waves. These heat waves often cause degradation of image quality. Low power eyepieces, like the SP 20mm eyepiece, magnify these heat waves less than higher power eyepieces. Therefore, low power eyepieces provide a steadier, higher quality image. If the image is fuzzy or ill-defined, reduce to a lower power, where the heat waves do not have such an effect on image quality. Observing in early morning hours, before the ground has built up internal heat, produces better viewing conditions than during late-afternoon hours.

Astronomical Observing

Used as an astronomical instrument, the ETX-70EC has many optical and electromechanical capabilities. It is in astronomical applications where the extremely high level of optical performance of the ETX-70EC is readily visible. The range of observable astronomical objects is, with minor qualification, limited only by the observer's motivation.

Sidereal Rate

As the Earth rotates beneath the night sky, the stars appear to move from East to West. The speed at which the stars move is called the *sidereal rate*.

If the telescope is polar aligned (enabled by mounting the telescope to one of the optional tripods) the motor drive in the ETX-70EC is designed to rotate the telescope at the sidereal rate so that it automatically tracks the stars. This tracking makes it easy to locate objects and keep them centered in the telescope's eyepiece.

Never use a Meade ETX-70EC 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.

Slew Speeds

The Electronic Controller has four slew speeds that are directly proportional to the sidereal rate. These speeds are signified by the Electronic Controller indicator lights (2, Fig. 5) and have been calculated to accomplish specific functions.

Light 1: The fastest slew speed moves the telescope quickly from one point in the sky to another.

Light 2: The next fastest speed is best used for rough centering of the object in the eyepiece.

Light 3: The third speed is set to enable centering the object in the field of a low-to-moderate power eyepiece such as the standard SP 20mm.

Light 4: The slowest slew speed is for centering an object in the field of view of a high power eyepiece such as the standard MA 9mm.

The four available speeds are:

Light 1	=	1200 x sidereal	(300 arc-min/sec *or* 5°/sec)
Light 2	=	180 x sidereal	(45 arc-min/sec *or* 0.75°/sec)
Light 3	=	32 x sidereal	(8 arc-min/sec *or* 0.13°/sec)
Light 4	=	8 x sidereal	(2 arc-min/sec *or* 0.034°/sec)

The two slowest speeds (8x and 32x sidereal) should be used for pushbutton tracking of astronomical objects, while observing through the eyepiece.

CHAPTER 2

THE ELECTRONIC CONTROLLER

Briefly described on page 6, the Electronic Controller is the primary method used to move the ETX-70EC telescope. Electronic Controller functions include: slewing the telescope (see **Observing with the Electronic Controller**, page 6); turning on the telescope motor drive to automatically track celestial objects (when the telescope is polar aligned); changing the hemisphere of operation, when required; and changing tracking speed (see **APPENDIX A**, page 19).

Modes of Operation

The Electronic Controller can be set to operate in either of two primary modes: the **Alt/Az** mode (used when the telescope is operated in the altazimuth configuration; see page 8) and the **polar** mode (used when the telescope is equatorially-mounted and polar-aligned; see page 9).

- **Alt/Az** (altitude-azimuth, or vertical-horizontal) mode should be chosen for all terrestrial operations of the telescope. In the Alt/Az mode the arrow keys can be used to slew the telescope to terrestrial or astronomical objects and, once located, to follow these objects if they move. However, in this mode astronomical tracking is not automatic and requires continuous key pushes. *As the telescope is removed from its original packing box, the Electronic Controller is factory pre-set to the Alt/Az mode.*
- **Polar** mode should be chosen in cases where the telescope is equipped with either the optional #880 Table Tripod, or #883 Deluxe Field Tripod, permitting polar-alignment of the telescope for extensive astronomical observations. In this mode the arrow keys may be used to slew the telescope to objects, as in the Alt/Az mode above, but in addition the telescope's internal motor drive is turned on, enabling fully automatic tracking of celestial objects.

Two methods are available to change the Electronic Controller between the Alt/Az and polar modes:

1. Physically remove one of the mode screws (see **Using the Mode Screws**, below).
2. Use the MODE key on the Electronic Controller as described in **Electronic Controller Modes**, opposite.

Using the Mode Screws

The Electronic Controller has two screws on the bottom rear of the handbox that can be removed to change the "default" mode of the Electronic Controller to Alt/Az or polar and, if polar, which of the Earth's hemispheres the observer is located in.

NOTE: Mode screws A and B are the outer screws in the recess directly under the letters A and B on the rear of the Electronic Controller. Do not remove either of the inner two screws in the recess.

Mode Screw A (1, Fig. 9): Remove Mode Screw A to automatically default the Electronic Controller to *Northern Hemisphere Polar* mode when power is applied (i.e., the motor drive is activated for operation in the Earth's northern hemisphere — the U.S.A., Europe, Japan, etc.).

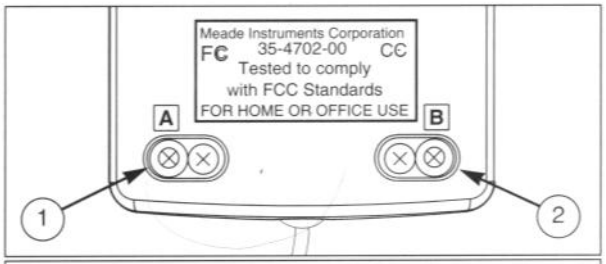


Fig. 9: Mode screws on rear of Electronic Controller.
(1) Mode Screw A; (2) Mode Screw B.

Mode Screw B (2, Fig. 9): Remove Mode Screw B to automatically default the Electronic Controller to *Southern Hemisphere Polar* mode when power is applied (i.e., the motor drive is activated for operation in the Earth's southern hemisphere — Australia, South America, Africa, etc.).

NOTES: (1) Leaving both A and B screws in place (or removing both screws) keeps the telescope in its original Alt/Az mode. (2) Removing either A or B screw only affects the telescope's default *mode; the observer may still make mode changes at will during telescope operation using the MODE key (see **Electronic Controller Modes**, below).*

Electronic Controller Modes

The Electronic Controller is in the Alt/Az mode when activated, unless a mode screw has been removed. To use the Electronic Controller to change to northern or southern hemisphere polar mode, or to use Alt/Az mode with one of the mode screws removed, follow this procedure:

1. Complete the **Polar Alignment Procedure** on page 11.
2. Complete steps 2 through 8 in **Observing with the Electronic Controller** (page 7) to initialize the Electronic Controller.

3. Press and hold the MODE key (5, Fig. 5) until Lights 1 and 2 are on steady and Lights 3 and 4 start blinking.

4. Press the SPEED key (3, Fig. 5) once. This changes the system to polar mode for the Earth's southern hemisphere with the motor drive set to operate at the sidereal rate.

5. Press the SPEED key a second time. This changes the system to polar mode for the Earth's northern hemisphere with the motor drive set to operate at the sidereal rate.

6. Press the SPEED key a third time and the system returns to the Alt/Az mode. *In the Alt/Az mode the motor drive does not activate when exiting from the Mode function.*
7. Use the SPEED key as described in the above steps to cycle between these three modes (i.e., Alt/Az, southern hemisphere polar, or northern hemisphere polar) until the desired mode is shown by the appropriate light configuration.

8. Press and hold the MODE key until only a single light is on. This exits the Mode function. If northern or southern hemisphere polar mode was chosen, the motor drive starts operating at the sidereal rate.
9. Use the four arrow keys (1, Fig. 5) to slew the telescope to the desired object. To change the slew speed, press the SPEED key.

*NOTE: See **APPENDIX A** (page 19) for advanced functions of the Electronic Controller.*

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. 9).

To polar align the ETX-70EC 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.

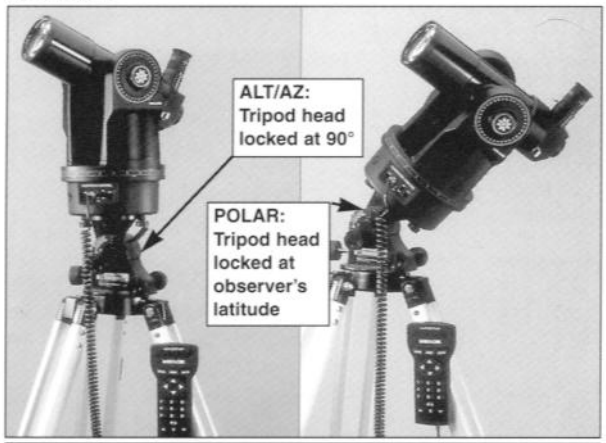


Fig. 10: Examples of Alt/Az and polar mounting of the ETX-70EC to the optional #883 Deluxe Field Tripod.

Celestial Coordinates

Celestial objects are mapped according to a coordinate system on the Celestial Sphere (Fig. 11), 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.

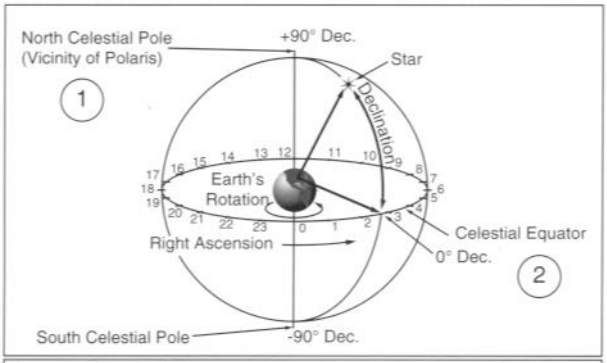


Fig. 11: Celestial Sphere.

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. 11) 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.

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. 11) 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, or "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. 14).

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**, page 9) is not obvious to the unaided eye, but viewed through a serious telescope such as the ETX-70EC, 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-70EC should be *polar aligned.*

There are two mounting methods available to polar align the telescope: the optional #883 Deluxe Field Tripod or the #880 Table Tripod.

To Polar align using the #883 Deluxe Field Tripod (Fig. 10), follow the instructions provided with the tripod. To Polar align using the #880 Table Tripod, follow the procedure below.

1. Remove the two hole covers (12, Fig. 1) from the side of the drive base and thread the two identical fixed legs (4, Fig. 13) into these holes to a *firm feel* only.
2. Determine the latitude of the observing location from a road map, atlas, or from the **Latitude Chart for Major Cities of the World**, page 20; determining the latitude within about one degree is sufficient.
3. The #880 Table Tripod is equipped with two adjustable tripod legs: The *standard tripod leg* is used at observing latitudes as shown in the box in step 4 and has a dual latitude label attached (Fig. 12). The *high-latitude tripod leg* is shorter and is used at higher observing latitudes.

CHAPTER 3

Based on the observing latitude determined in step 2, set aside the tripod leg that is not to be used.

4. Locate the two mounting holes on the bottom of the telescope drive base. Mount the appropriate adjustable tripod leg (as determined in step 3) to the drive base using the following latitudes:

Standard Tripod Leg
32.5° to 48.5° uses *High-Latitude* hole (2, Fig. 16).
22° to 35.5° uses *Alternate* hole (3, Fig. 16).

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.

5. A small thumbscrew (6, Fig. 13) 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 8.)

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: When using the #880 Table Tripod with the ETX-70EC, the optional #1422 Low-Latitude Balance Weight (8, Fig. 13) is recommended if the telescope is to be polar aligned below 30°, or if heavy accessories are attached to the eyepiece-end of the telescope.

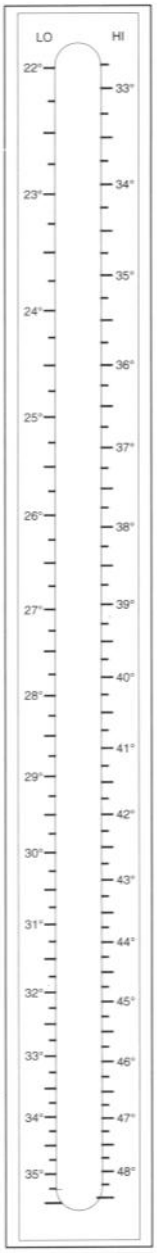


Fig. 12: Example of Standard Tripod Leg Latitude Scales.

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 faces 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.

6. Loosen the vertical and horizontal locks (6 and 9, Fig. 1) and rotate the telescope so that it is oriented as shown in Fig. 13. Tighten the vertical and horizontal locks. In this orientation the telescope's optical tube is lined up parallel to the tripod's adjustable leg.

7. Note the line and arrow extending from the telescope tube in Fig. 13. 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 *(i.e., if the location of Polaris, the North Star, is known then point the telescope directly at Polaris).*

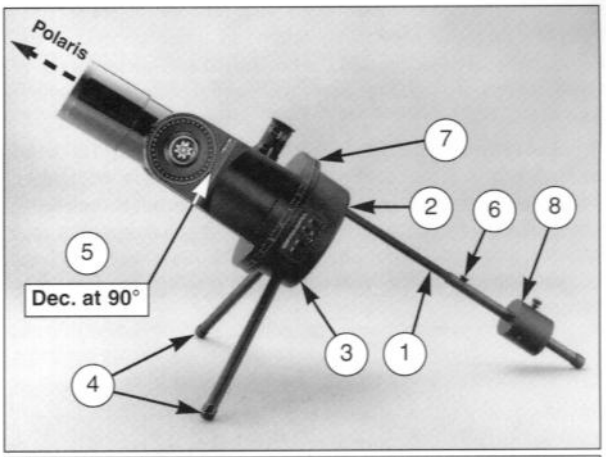


Fig. 13: Example of polar alignment using the #880 Table Tripod and ETX-70EC. (1) Standard Tripod Leg with Latitude Scale; (2) High Latitude Hole; (3) Alternate Hole; (4) Fixed Tripod Legs; (5) Declination Pointer; (6) Thumbscrew; (7) R.A. Scale Pointer; (8) #1422 Low-Latitude Balance Weight.

8. 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. 13.

NOTE: Observers located in the earth's southern hemisphere (e.g., South America, Africa, Australia, etc.) should point the telescope's polar axis due South.

9. With the telescope now polar-aligned the table 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 9, Fig. 1), which permits the optical tube to be moved freely within the telescope mounting, or (b) more generally, with the locks in their "locked" positions, by using the arrow keys of the Electronic Controller.

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**, page 21.

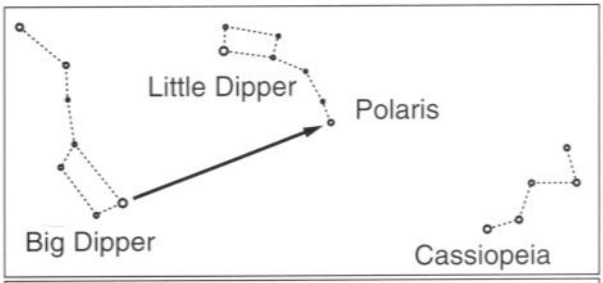


Fig. 14: Locating Polaris.

RALEIGH LAT. 35°52' N.

OBJECTS IN SPACE

Listed below are some of the many astronomical objects that can be seen with the ETX-70EC.

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. 15). 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-70EC, brilliant detail can be observed on the Moon, including hundreds of lunar craters and maria, described below.

Fig. 15: 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.

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-70EC.

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-70EC. 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. 16) is an open cluster 410 light years away. Through the ETX-70EC numerous stars are visible.

Fig. 16: The Pleiades Star Cluster (M45) in the constellation Taurus.

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.

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-70EC.

CHAPTER 4

PHOTOGRAPHY WITH THE ETX-70EC

Photography through the ETX-70EC requires the addition of the optional #64ST T–Adapter (see **OPTIONAL ACCESSORIES**, page 15). With the #64ST T-Adapter attached to the telescope (Fig. 17), 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, (15, Fig. 1) to the "down" position, allowing light to pass straight through the telescope and out the photo port (16, 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 #64ST T-Adapter (1, Fig. 17) threads on to the photo port, followed by a T-Mount (2, Fig. 17) for the particular brand of 35mm camera being used, followed by the camera body (3, Fig. 17).

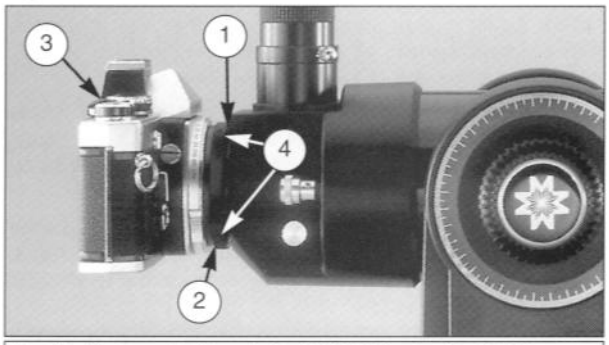


Fig. 17: Photography through the ETX-70EC using the #64ST T–Adapter. (1) T-Adapter; (2) T-Mount; (3) 35mm Camera Body (with camera lens removed); (4) T-Mount Adjustment Screws.

To frame an object in the viewfinder of the 35mm camera body, use a small jeweler's screwdriver to slightly loosen three adjustment screws (4, Fig. 17) around the outer knurled ring of the T-Mount. Rotate the camera body to achieve proper framing of the object; then re-tighten the adjustment screws.

The #64ST T–Adapter permits close-coupling of a camera body to the telescope at a focal length of 350mm and an effective photographic speed of f/5. 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. 18).

Fig. 18: Example of photography through ETX-70EC showing vignetting.

When removing the T-Adapter and T-Mount from the photo port, the T-Adapter may become torqued to either the photo port or the T-Mount. If this occurs, the T-Adapter has a slot on both sides which may be used to loosen the T-Adapter. Place a metal straight edge, or similar instrument across the two slots and turn *counterclockwise* to remove the T-Adapter.

Photography through a long lens such as the ETX-70EC 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 with the ETX-70EC:

1. Use the optional #880 Table Tripod or the #883 Deluxe Field Tripod as a platform for the telescope. At an effective focal length of 350mm, even small external vibrations can easily ruin an otherwise good photo.

CAUTION: With the #64ST T-Adapter and a camera body mounted to the ETX-70EC 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-70EC's focus knob (8, 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-70EC may have an 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-70EC 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–70EC 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**, page 11), and that the telescope's motor drive be in operation (see **Electronic Controller Modes**, page 10).

NOTE: Long exposure photography of deep-sky objects is not practical with the ETX-70EC, since this type of photography requires special electronic and optical guiding devices not available for this telescope.

A wide assortment of professional Meade accessories are available for the ETX-70EC. 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 telescopes, are available at more than 2000 dealer locations in the U.S. and Canada and through Meade international distributors worldwide. Once you have identified the accessories you wish to order, contact your local Meade authorized dealer. To find a dealer near you call (949) 451-1450 or visit the Meade website at ***www.meade.com***.

#495 Autostar™ Computer Controller: One of the most important advances in telescope control in the past 25 years, the Meade #495 Autostar Computer Controller (Fig. 19) turns the ETX-70EC into an automatic celestial object locating system. Just plug Autostar into the telescope's HBX port in place of the standard-equipment Electronic Controller, do a quick telescope alignment, and you're ready to observe any object in the Autostar's 1,500-object database.

Fig. 19: #495 Autostar Computer Controller.

Best of all, the Meade Autostar is easy to use. Even the most novice observer will locate dozens of fascinating objects the very first night out — from commonly-observed objects such as the rings of Saturn, the satellites of Jupiter, and the Orion Nebula (M42), to more difficult objects such as the Ring Nebula (M57) in Lyra, the Spiral Galaxy (M33) in Triangulum, and the Sombrero Galaxy (M104) in Virgo

Any of Autostar's database objects can be called up and entered on the hand controller display in seconds. The observer then simply presses the GO TO pushbutton and watches as the telescope automatically slews to the object and places it in the field of view. The effect of Autostar is to bring objects easily within reach which were previously unreachable for all but the most dedicated of amateur astronomers.

Astro Software/Cable Connector Kit: Meade ETX-70EC Astro Telescope equipped with the Autostar Computer Controller may be used in conjunction with Meade astro software to operate the telescope in the GO TO mode directly from the display of the personal computer. With the Meade astro software loaded into the PC, and with the PC connected to the telescope through Autostar's RS-232 serial interface (using the **#505 Cable Connector Set** included with each astro software Package) the observer can point and click on any object shown on the PC display. The telescope then slews to the object at 5° per second on both telescope axes and places the object in the telescopic field of view.

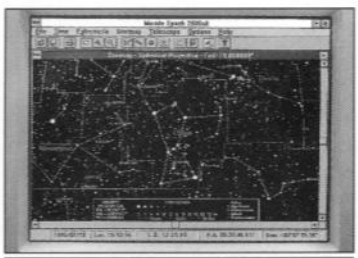


Fig. 20: Astro software.

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. 25) permit a wide range of magnifying powers with the ETX-70EC. Powers obtained with each available eyepiece are shown in the following table:

Fig. 21: Optional Eyepieces yield higher and lower magnifying powers with the telescope.

Eyepiece	Power	2X Barlow *
MA 9mm *	39X	78X
SP 6.4mm	54X	108X **
SP 9.7mm	36X	72X
SP 12.4mm	28X	56X
SP 15mm	23X	46X
SP 20mm *	17.5X	35X
SP 26mm	13.5X	27X
SP 32mm	11X	22X
SP 40mm	9X	18X
SWA 13.8mm	25X	50X
SWA 18mm	19X	38X
SWA 24.5mm	14X	28X
UWA 4.7mm	74X	N/A
UWA 6.7mm	52X	104X **

* Included as standard-equipment with the ETX-70EC.

** Use these eyepieces only under extremely steady atmospheric conditions.

Meade Super Plössl and Super Wide Angle Eyepieces are ideal for general-purpose astronomical or terrestrial observing. The typical ETX-70EC user may wish to add two or three of these eyepieces to his or her telescope. An introductory selection might include the SP 6.4mm and SP 40mm eyepieces, while the more advanced observer might select the SP 6.4mm, SP 32mm, 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.

#64ST T-Adapter: The basic means of photography through an ETX-70EC, the #64ST T-Adapter (Fig. 17) threads to the rear cell of the telescope, followed by a T-Mount appropriate to the user's brand of 35mm camera. In this way, the camera body is rigidly coupled to the telescope's optical system, which in effect becomes the camera's lens (see **PHOTOGRAPHY WITH THE ETX-70EC**, page 14).

#880 Table Tripod: The ETX-70EC permits pushbutton tracking of astronomical objects from the standard-equipment Electronic Controller. For fully automatic tracking a table tripod (1 and 2, Fig. 22), or the #883 Deluxe Field Tripod may be added allowing for polar alignment of the telescope. Each table tripod includes two fixed legs and two variable-length legs inscribed with a range of latitude settings for quick polar alignment. The #880 Table Tripod attaches quickly to the telescope drive base. Two identical fixed tripod legs (2, Fig. 22) mount to holes on the side of the drive base. The adjustable

CHAPTER 5

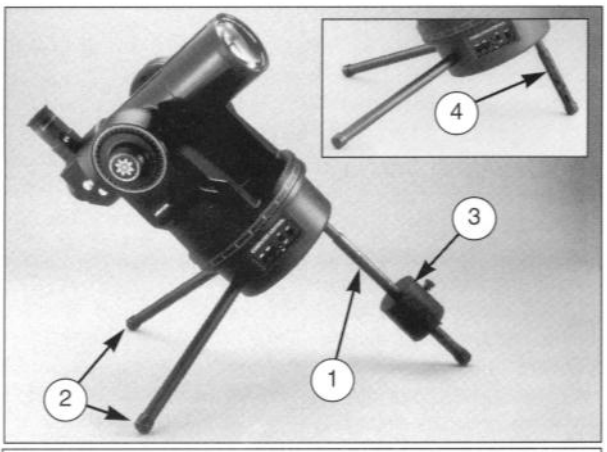


Fig. 22: Using the #880 Table Tripod with the ETX-70EC. (1) Standard Tripod Leg; (2) Fixed Tripod Legs; (3) Balance Weight; (4) High-Latitude Tripod Leg.

standard tripod leg (1, Fig. 22), 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 (4, Fig. 22) is substituted for the standard tripod leg at latitudes between 44° and 66°.

#1422 Low-Latitude Balance Weight: If the ETX-70EC 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 Low-Latitude Balance Weight (3, Fig. 22) slides on to the standard tripod leg and enables rock-solid stability of the telescope even at lower latitudes.

#933 45° Erecting Prism: The ETX-70EC includes an internal optically-flat mirror to reflect light to the telescope's 90° astronomical observing position; in this position the telescope's image is upright, but reversed. The #933 incorporates a 2.4X Barlow lens which doubles the magnification of any eyepiece. For terrestrial observing with the ETX-70EC the #933 45° Erecting Prism (1, Fig. 23) results in a fully correctly oriented image and a convenient 45° observing angle. The #933 Prism threads on to the telescope's photo port (16, Fig. 1). An eyepiece of any focal length (magnifying power) may be inserted into the #933 Prism. Note that the flip-mirror control (15, Fig. 1) must be in the "down" position for use with the #933 Prism.

Important Note: *In the most discriminating applications, such as in observing delicate bird feather-structure at long distance, the ETX-70EC telescopes' internal, optically-flat mirror yields a higher-resolution image than is possible with any prism, including the #933. In these special cases ETX-70EC 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.*

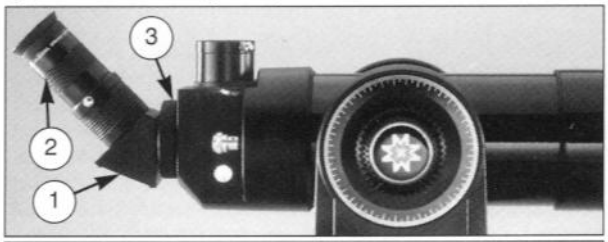


Fig. 23: The #933 45° Erecting Prism shown threaded to the rear cell of the ETX-70EC. (1) #933 45° Erecting Prism; (2) Eyepiece; (3) Knurled Lock-ring.

#883 Deluxe Field Tripod: Manufactured of strong, lightweight extruded aluminum, the #883 Deluxe Field Tripod (Fig. 24) allows standing or seated observations through the ETX-70EC. 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 (inset, Fig. 23). Designed exclusively for ETX model 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°.

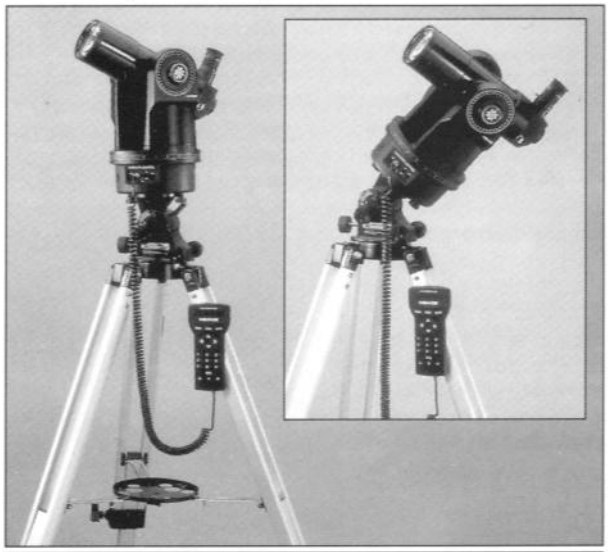


Fig. 24: The #883 Deluxe Field Tripod set up in the Alt/Az configuration (tripod head locked at 90°), for terrestrial applications. (Inset) Tripod head tilted for polar alignment.

Power Adapters and Cords: In addition to the internal battery pack, the ETX-70EC may be powered from standard 115v. AC home electricity with the **#541 AC Adapter**. The #541 plugs into any standard home outlet and includes a 25 ft. cord connecting to the telescope's control panel; input voltage to the telescope is 12vDC. Alternately, the telescope may be powered in the field from an automobile cigarette lighter plug by using the **#607 Power Cord** (Fig. 25), a 25 ft. cord which plugs into the telescope's control panel and supplies 12v.DC directly from the car battery.

Fig. 25: #607 Power Cord.

#773 Hard Case: For secure portability of the ETX-70EC in the field, the #773 Hard Case (Fig. 26) is fully lined with fitted foam inserts and accept the complete telescope and accessories *(e.g., additional eyepieces, table tripod, the Electronic Controller, Autostar, and much more).*

Fig. 26: #773 Hard Carrying Case for the ETX-70EC.

CHAPTER 6

General Maintenance

The ETX-70EC Astro Telescope is a precision optical instrument designed to yield a lifetime of rewarding applications. Given the care and respect due any precision instrument, the ETX-70EC will rarely 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. If the ETX-70EC 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.
5. If the ETX-70EC 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**, page 5).
6. Do not leave the ETX-70EC 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.
7. A (English-format) hex wrench is provided with the ETX–70EC. Use the wrench to tighten the set-screws of any knobs which may loosen (e.g., the horizontal lock knob, focus knob or flip-mirror control knob).

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 9, 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 an optional #773 Hard Case to transport the telescope (see **OPTIONAL ACCESSORIES**, page 16).

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 the lens or reflected off the mirror, 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 with operation of the ETX-70EC.

The power indicator light on the telescope 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**, page 5).

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 (15, Fig. 1) is in the "up" position if using the eyepiece holder (3, 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 #933 Erecting Prism or doing photography with the ETX-70EC (see **Telescope Controls**, page 6 and **PHOTOGRAPHY WITH THE ETX-70EC**, page 14).

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 illuminated 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 (see **Electronic Controller Modes**, page 10).
- The battery power may be low (see **Assembly Instructions**, page 5).

CHAPTER 6

Telescope does not track a celestial object:

- The telescope only tracks celestial objects automatically if it is placed in the polar mode (see **Modes of Operation**, page 10) and the telescope is polar aligned (see **Polar Alignment Procedure**, page 11) using either the #880 Table Tripod, or the #883 Deluxe Field Tripod (see **OPTIONAL ACCESSORIES**, page 16). The more accurate the polar alignment, the longer the telescope's motor drive holds an object in the field of view of the eyepiece. If using the Alt/Az mode, tracking of celestial objects is accomplished by using the directional arrows on the Electronic Controller. To automatically track objects in the Alt/Az mode the optional #495 Autostar Computer Controller is required.

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 (see **Understanding Magnification**, page 8).
- 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**, page 9).
- For clear viewing of objects, turn the focus knob (8, 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.

When turning the focus knob it takes a moment for the image to change:

- The focus knob may need to be reset. Verify that the dust cover is in place at the front of the objective lens cell (5, Fig. 1). Turn the optical tube so that is pointing straight up through the fork arms and lock the vertical lock. Carefully, turn the telescope upside down so that the front of the objective lens cell is resting on a clean, flat surface. Use the provided hex wrench to slightly loosen the focus knob set screw. Make sure the focus knob is flush against the rear cell of the telescope and retighten the focus knob set screw.

Telescope moves off a terrestrial object while observing:

- The motor drive may be activated (see **Modes of Operation**, page 10).
- Verify that the vertical and horizontal locks are tight (see **Telescope Controls**, page 6).

Telescope does not move past a certain point:

- The built-in vertical or horizontal rotational "stops" may have been reached (see **Rotational Limits**, page 6).

Telescope pauses when changing slew direction:

- This pause is normal (see **Arrow Keys**, page 6).

A terrestrial object appears reversed left-for-right:

- An eyepiece in the standard 90° observing position (3, Fig. 1) yields this image orientation. To view a correctly oriented image, the optional #933 Erecting Prism is required (see **OPTIONAL ACCESSORIES**, page 16).

Meade Customer Service

If you have a question concerning your ETX-70EC, 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 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-70EC Astro Telescope

Optical design	Achromatic Refractor
Clear aperture	70mm (2.76")
Focal length	350mm
Focal ratio (photographic speed)	f/5
Near focus (approx.)	17 ft (5.2m)
Resolving power	1.6 arc secs
Super multi-coatings (EMC)	standard
Limiting visual stellar magnitude (approx.)	11.5
Image scale	4.1°/inch
Maximum practical visual power	110X
Optical tube dimensions (dia. x length)	8.9cm x 30.4-37.1cm (3.5" x 12-14.6")
Eyepieces	
Super Plössl	SP 20mm
Modified Achromat	MA 9mm
Telescope mounting	fork type; double tine
Setting circle diameters	Dec: 3.5"; RA: 7"
Input voltage	12-volts DC
Motor Drive System	DC servo motors with encoders, both axes
Slow-Motion Controls	electric, 4 speed, both axes
Optional Autostar Capability	yes
Hemispheres of operation	north and south, switchable
Bearings:	
Altitude	UHMW Polyethylene
Azimuth	PTFE
Materials:	
Tube body	aluminum
Mounting	high-impact ABS, aluminum-reinforced
Objective lens (crown, flint)	BK7, F2
Telescope dimensions	40.4cm x 18cm x 22cm (15.9" x 7" x 9")
Telescope net weight:	
(incl. Electronic Controller & batteries)	3.1kg (6.8 lbs)
Telescope shipping weight	5.6kg (12.3 lbs)
Battery Life (approx.)	
with Electronic Controller	45 hrs
with Autostar	20 hrs

Appendix A: TRACKING MOTOR SPEED

APPENDIX A

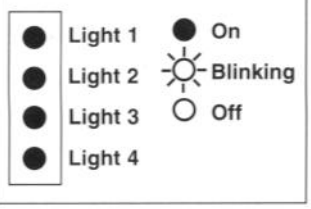
In the polar mode the Electronic Controller normally tracks objects at the sidereal rate (see **Sidereal Rate**, page 9). For most observing sessions (once the telescope has been polar aligned and the tracking motor activated) there is little need to change this speed.

For objects such as the Moon or a comet that move at slightly different rates, the Electronic Controller arrow keys (1, Fig. 5) are sufficient to move the telescope slightly as the object very slowly moves off-center through the eyepiece field.

To change the tracking rate, for extended observations of an object not moving at the sidereal rate, follow the procedure for the appropriate hemisphere:

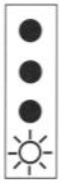
Indicator Light Key

The procedures in this manual identify the status of the four indicator lights in a box to the left of the appropriate step. They are depicted as *On*, *Blinking* or *Off*, depending on the mode at that point.

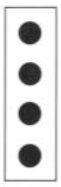


Northern Hemisphere Polar:

1. Press and hold the MODE key (5, Fig. 5) until the Mode function is active (i.e., Lights 1 and 2 are on steady; Lights 3 and 4 signify whatever tracking mode was last chosen).

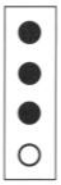


2. Press the SPEED key (3, Fig. 5) until Lights 1, 2, and 3 are on steady with Light 4 blinking. The telescope is now in the Northern Hemisphere Polar mode.



3. Press the IN key and Light 4 comes on steady. The tracking rate is now 0.5% *faster* than sidereal. Continue pressing IN until the desired speed is reached.

NOTE: The tracking rate can be increased by up to 65% (127 presses of the IN key).



4. To use a rate slower than sidereal, press the OUT key until Light 4 blinks again (sidereal rate). Press the OUT key again and Light 4 goes out, signifying a tracking rate 0.5% *slower* than sidereal. Pressing an additional 3 to 4 times will slow the tracking rate to the Lunar rate.

NOTE: The tracking rate can be decreased by up to 65% (127 presses of the OUT key).

5. Press and hold the MODE key until only a single light is on. This exits the Mode function. If northern or southern hemisphere polar mode was chosen, the motor drive starts operating at the sidereal rate.
6. Use the four arrow keys (1, Fig. 5) to slew the telescope to the desired object. To change the slew speed, press the SPEED key.

Southern Hemisphere Polar:

1. Press and hold the MODE key (5, Fig. 5) until the Mode function is active (i.e., Lights 1 and 2 are on steady; Lights 3 and 4 signify the tracking mode last chosen).

2. Press the SPEED key (3, Fig. 5) until Lights 1 and 2 are on steady, Light 3 is off, and Light 4 is blinking.

3. Press the IN key and Light 4 comes on steady. The tracking rate is now 0.5% *faster* than sidereal. Continue pressing IN until the desired speed is reached.

NOTE: The tracking rate can be increased by up to 65% (127 presses of the IN key).

4. To use a rate slower than sidereal, press the OUT key until Light 4 blinks again (sidereal rate). Press the OUT key again and Light 4 goes out, signifying a tracking rate 0.5% *slower* than sidereal. Pressing an additional 3 to 4 times will slow the tracking rate to the Lunar rate.

NOTE: The tracking rate can be decreased by up to 65% (127 presses of the OUT key).

5. Press and hold the MODE key until only a single light is on. This exits the Mode function. If northern or southern hemisphere polar mode was chosen, the motor drive starts operating at the sidereal rate.
6. Use the four arrow keys (1, Fig. 5) to slew the telescope to the desired object. To change the slew speed, press the SPEED key.

APPENDIX B

Latitude Chart for Major Cities of the World

To aid in the polar alignment procedure (see page 11), latitudes of major cities around the world are listed below. To determine the latitude of an observing site not listed on the chart, locate the city closest to your site. Then follow the procedure below:

Northern hemisphere observers (N): If the site is over 70 miles (110 km) north of the listed city, add one degree for every 70 miles. If the site is over 70 miles south of the listed city, subtract one degree per 70 miles.

Southern hemisphere observers (S): If the site is over 70 miles north of the listed city, subtract one degree for every 70 miles. If the site is over 70 miles south of the listed city, add one degree per 70 miles.

UNITED STATES

City	State	Latitude
Albuquerque	New Mexico	35° N
Anchorage	Alaska	61° N
Atlanta	Georgia	34° N
Boston	Massachusetts	42° N
Chicago	Illinois	42° N
Cleveland	Ohio	41° N
Dallas	Texas	33° N
Denver	Colorado	40° N
Detroit	Michigan	42° N
Honolulu	Hawaii	21° N
Jackson	Mississippi	32° N
Kansas City	Missouri	39° N
Las Vegas	Nevada	36° N
Little Rock	Arkansas	35° N
Los Angeles	California	34° N
Miami	Florida	26° N
Milwaukee	Wisconsin	46° N
Nashville	Tennessee	36° N
New Orleans	Louisiana	30° N
New York	New York	41° N
Oklahoma City	Oklahoma	35° N
Philadelphia	Pennsylvania	40° N
Phoenix	Arizona	33° N
Portland	Oregon	46° N
Richmond	Virginia	37° N
Salt Lake City	Utah	41° N
San Antonio	Texas	29° N
San Diego	California	33° N
San Francisco	California	38° N
Seattle	Washington	47° N
Washington	District of Columbia	39° N
Wichita	Kansas	38° N

EUROPE

City	Country	Latitude
Amsterdam	Netherlands	52° N
Athens	Greece	38° N
Bern	Switzerland	47° N
Copenhagen	Denmark	56° N
Dublin	Ireland	53° N
Frankfurt	Germany	50° N
Glasgow	Scotland	56° N
Helsinki	Finland	60° N
Lisbon	Portugal	39° N
London	England	51° N
Madrid	Spain	40° N
Oslo	Norway	60° N
Paris	France	49° N
Rome	Italy	42° N
Stockholm	Sweden	59° N
Vienna	Austria	48° N
Warsaw	Poland	52° N

Star Locator

Following are a list of bright stars with their R.A. and Dec coordinates, along with the northern hemisphere season when these stars are prominent in the night sky. This list will aid the observer to find alignment stars at various times of the year. For example, if it is a midsummer evening in the northern hemisphere, Deneb in the constellation Cygnus, would be an excellent alignment star, while Betelgeuse could not be used because it is in the winter constellation Orion and thus, below the horizon.

Season	Star Name	Constellation	R.A.	Dec
Spring	Arcturus	Bootes	14h16m	19° 11"
Spring	Regulus	Leo	10h09m	11° 58"
Spring	Spica	Virgo	13h25m	-11° 10"
Summer	Vega	Lyra	18h37m	38° 47"
Summer	Deneb	Cygnus	20h41m	45° 17"
Summer	Altair	Aquilla	19h51m	08° 52"
Summer	Antares	Scorpious	16h30m	-26° 26"
Fall	Markab	Pegasus	23h05m	15° 12"
Fall	Fomalhaut	Piscis Austrinis	22h58m	-29° 38"
Fall	Mira	Cetus	02h19m	-02° 58"
Winter	Rigel	Orion	05h15m	-08° 12"
Winter	Betelgeuse	Orion	05h55m	07° 25"
Winter	Sirius	Canis Major	06h45m	-16° 43"
Winter	Aldebaran	Taurus	04h35m	16° 31"

SOUTH AMERICA

City	Country	Latitude
Asuncion	Paraguay	25° S
Brasilia	Brazil	24° S
Buenos Aires	Argentina	35° S
Montevideo	Uruguay	35° S
Santiago	Chili	34° S

ASIA

City	Country	Latitude
Beijing	China	40° N
Seoul	South Korea	37° N
Taipei	Taiwan	25° N
Tokyo	Japan	36° N
Victoria	Hong Kong	23° N

AFRICA

City	Country	Latitude
Cairo	Egypt	30° N
Cape Town	South Africa	34° S
Rabat	Morocco	34° N
Tunis	Tunisia	37° N
Windhoek	Namibia	23° S

AUSTRALIA

City	State	Latitude
Adelaide	South Australia	35° S
Brisbane	Queensland	27° S
Canberra	New South Wales	35° S
Alice Springs	Northern Territory	24° S
Hobart	Tasmania	43° S
Perth	Western Australia	32° S
Sydney	New South Wales	34° S
Melbourne	Victoria	38° S

APPENDIX C

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**, page 11, 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. 13).
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, 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-70EC 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**, page 16).

Setting Circles

The ETX-70EC is equipped with R.A. and Dec Setting Circles (13 and 17, 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-70EC 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. 27) 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 (10, Fig. 1) immediately under the R.A. circle.

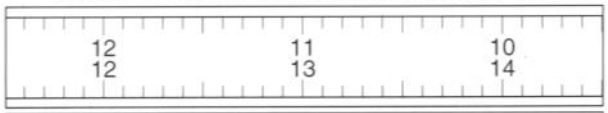


Fig. 27: Section of Right Ascension setting circle.

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. 28) 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.

  If for some reason this knob becomes loose and the Dec setting circle must be recalibrated, level the optical tube (4, 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. 13). Retighten the Dec knob.

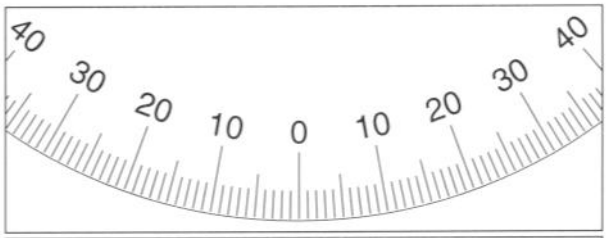


Fig. 28: Section of Declination setting circle.

To use the setting circles to find astronomical objects, the ETX–70EC must first be polar aligned; it is advisable that the motor drive be turned on (see **Modes of Operation**, page 10) and that a low-power eyepiece (e.g., the SP 20mm 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 20), or use a star chart. Center this object in the telescope's field of view.
2. Manually turn the R.A. circle (13, Fig. 1) to read the R.A. of the object at the R.A. pointer (7, Fig. 13).
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.

Appendix D: ROADMAP TO THE STARS

APPENDIX D

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.**

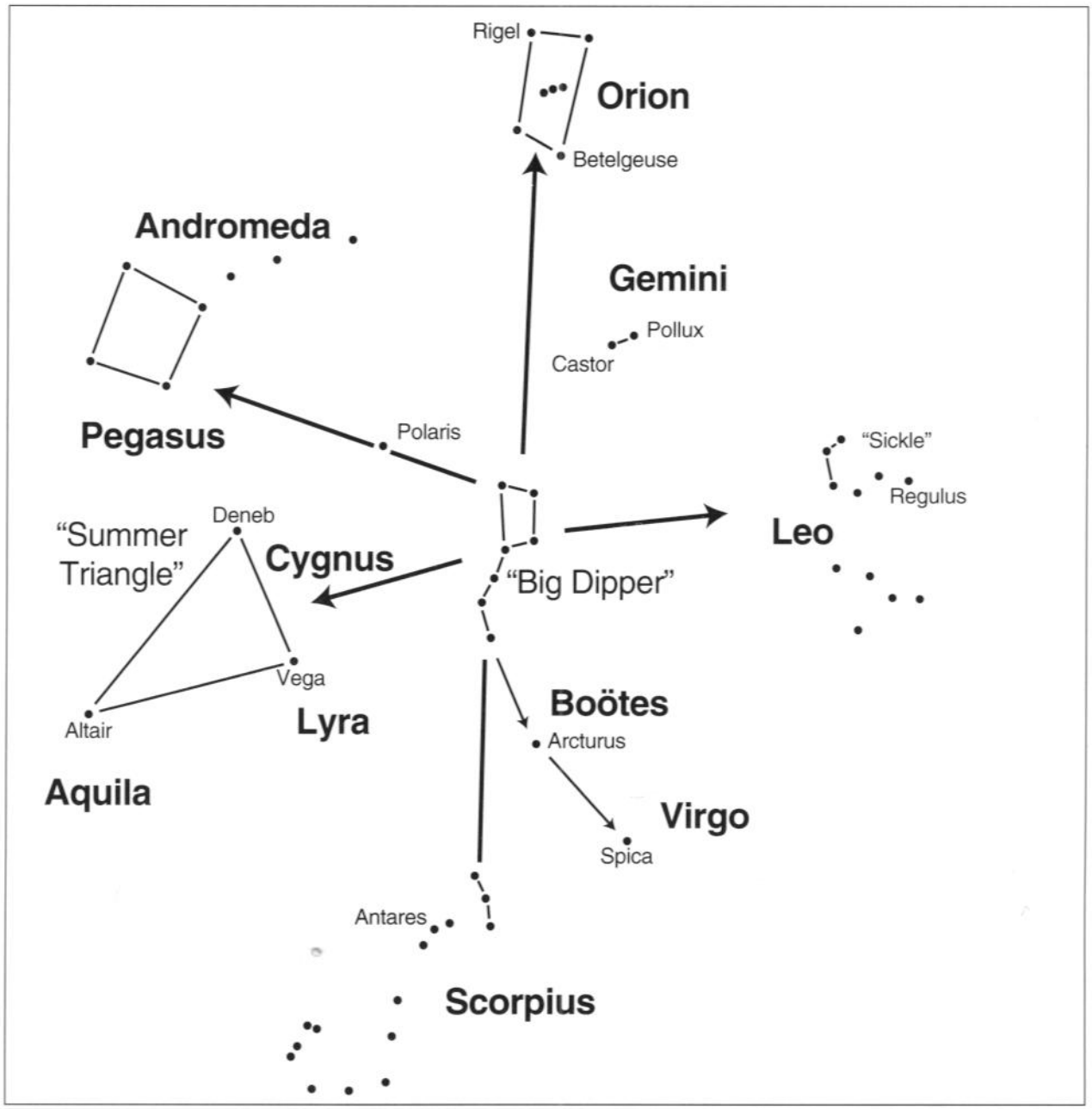


Fig. 29: Road Map to the Stars.

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Meade reserves the right to change product specifications or to discontinue products without notice.

This warranty supersedes all previous Meade product warranties.

WARNING

This equipment has been tested and found to comply with the limits for a CLASS B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions contained in this manual, may cause harmful interference to radio and television communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio of television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that of the receiver.
- Consult the dealer or an experienced audio television technician.

NOTE: Connecting this device to peripheral devices that do not comply with CLASS B requirements or using an unshielded peripheral data cable could also result in harmful interference to radio or television reception.

The user is cautioned that any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

To ensure that the use of this product does not contribute to interference, it is necessary to use shielded I/O cables.

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