# Instruction Manual

## **Goto-Kit** for equatorial EQ-5 Mounts


Art. No. 49-51700

# Telescope assemblies

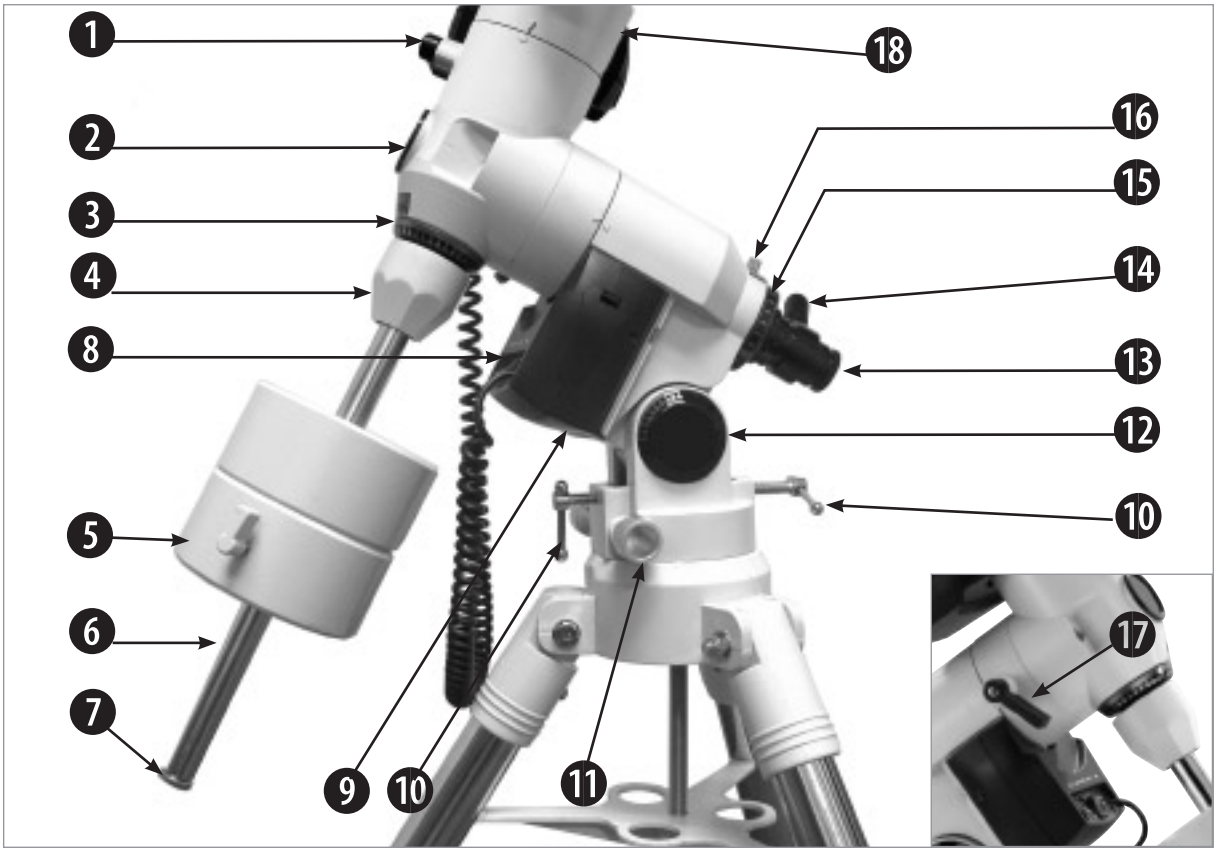



***Fig. 1a:*** *The LXD75-Series Mount; insert shows opposite side of Mount.*

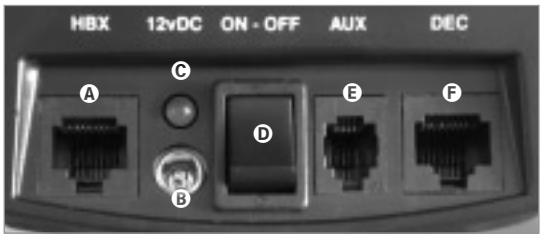
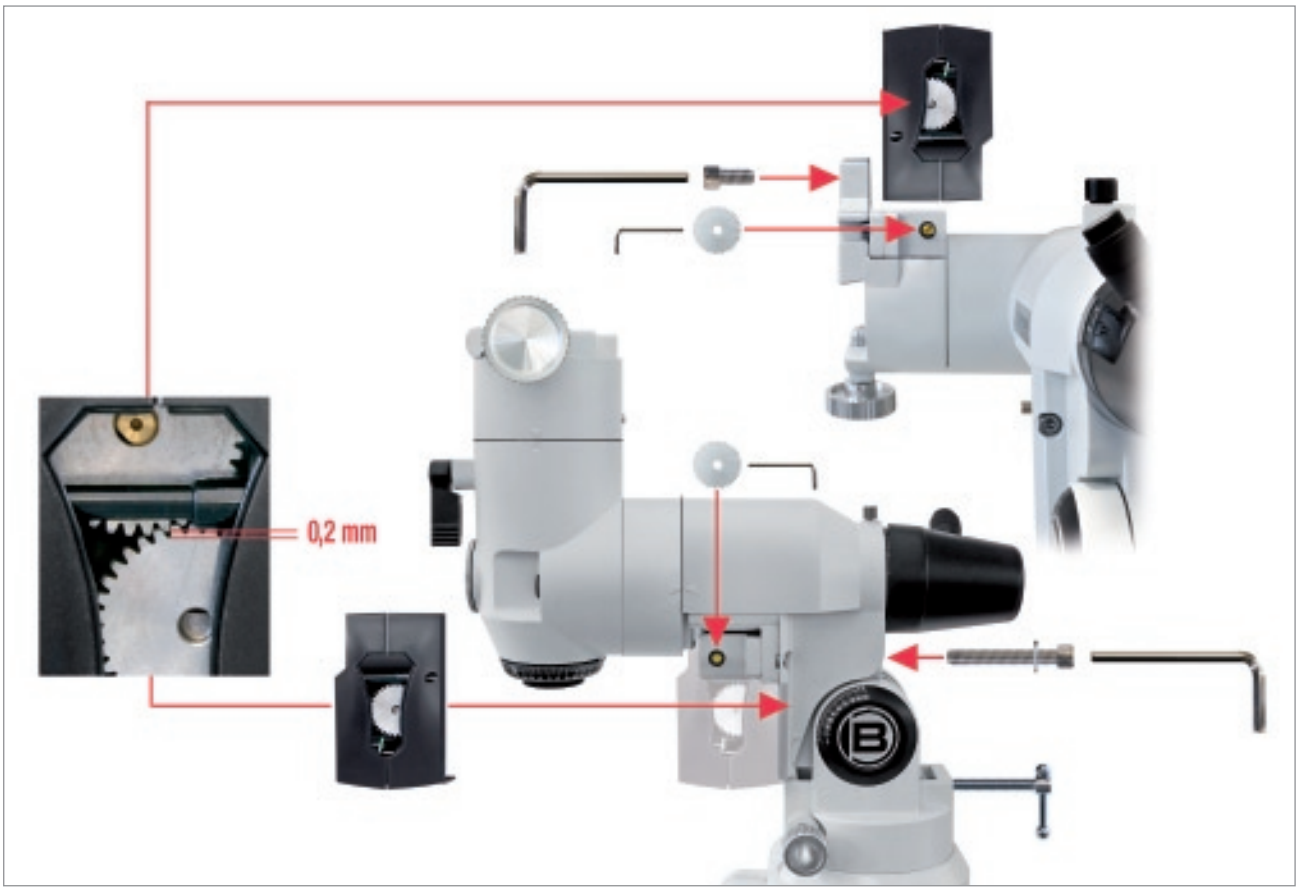



***Fig. 1d:*** *The LXD75-Series Computer Control Panel*

Legend
1. Dec. Lock
2. Polar VF Cap
3. Dec. Setting Circle
4. Counterweight Shaft Base
5. Counterweight, Lock Knobs
6. Counterweight Shaft
7. Counterweight Safety Cap
8. Computer Control Panel
9. R.A. Motor Drive
10. Latitude Adjustment Handles
11. Azimuth Control Knobs
12. Latitude Dial
13. Polar Alignment VF
14. Polar Alignment Reticle, LED
15. R.A. Setting Circle
16. R.A. Setting Circle Lock Knob
17. R.A. Lock
18. Dec. Motor Drive

# Installing the motors




## Warranty

The period of warranty is 2 years, beginning on the day of purchase. Please keep the cash receipt as evidence of purchase. Devices which become defective during the warranty period can be returned to the dealer where the device was bought. The repaired device or a new one will then be returned to you. In the case of defects which occur after the end of the warranty period, the devices can also be returned.

However, repairs which become necessary after the end of the warranty period will be subject to a service fee.

Important:

Make sure to return the device carefully packed in the original packaging in order to prevent transport damage. Please also enclose the cash receipt (or a copy). This warranty does not imply any restriction of your statutory rights.

Your dealer:

Name: .....

Postcode / Place: .....

Street: .....

Telephone: .....

Date of purchase: .....

Signature: .....

## WARNING!

**Never use the Newtonian 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 in the orientation indicated by illustration in the battery slots of the battery holder. Follow battery manufacturer‘s precautions. Do not install batteries backwards 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 warranty.

# Parts overview

***Attention:***
*Please handle this product with care. Damages, which resulted from inappropriate use, may void the warranty.*

***Caution** When loosening the Dec. lock, be sure to support the optical tube (**18, Fig. 1a**). The weight of the tube could cause the tube to swing suddenly.*

❶ **Declination (Dec.):** Controls the manual movement of the telescope. Turning the Dec. lock counterclockwise unlocks the telescope enabling it to be freely rotated by hand about the Dec. axis. Turning the Dec. lock clockwise (to a firm feel only) tightens the lock and prevents the telescope from being moved manually, but engages the Dec. motor drive (see ⓲ Fig. 1a) for Handbox operations.

❷ **Polar Viewfinder Cap:** Remove this cap when using the polar viewfinder (see ⓭ Fig. 1a).

❸ **Dec. Setting Circle**: See **APPENDIX A**, page 34, for more information.

❹ **Counterweight Shaft Base:** Thread, along with the shaft, to the mount. See page 11 for more information.

❺ **Counterweight and Counterweight Lock Knob:** Counterbalances the weight of the optical tube, and adds stability to the mount. Tighten the lock knob on the side of the counterweight to a firm feel to prevent the weight from sliding on the shaft.

❻ **Counterweight Shaft:** Slide the counterweight onto this shaft (see ❻ Fig. 1a).

❼ **Counterweight Safety Cap:** Prevents the counterweight from accidentally slipping off the end of the counterweight shaft.

❽ **Computer Control Panel (see Fig. 1a):**

- **A. Handbox (HBX) Port**: Plug the handbox coil cord (**7, Fig. 2**) into this port.
- **B. 12v DC Power Connector**: optional power connector (Art. No. 49-30000).
- **C. LED**: Illuminates when power is supplied to the handbox and the telescope's motor drive.
- **D. ON/OFF Switch**: Turns the Computer Control Panel and handbox ON or OFF.
- **E. AUX Port**: Provides connection for future accessories.
- **F. Dec Port**: Plug the coil cord from the Dec. motor assembly into this port for the handbox to control the motor drive.

❾ **Right Ascension (R.A.) Motor Drive Assembly:** Controlled by the handbox. Moves the optical tube along the R.A. axis. The R.A. Lock (see ⓱ Fig. 1a) must be tightened to a firm feel in order for the R.A. motor to operate.

❿ **Latitude Adjustment T-Handles (2)**: Sets the latitude of your observing location. The two T-handle screws work in a „push - pull" operation—as you tighten one, loosen the other.

⓫ **Fine Azimuth Control Knobs**: Fine tune the side-to-side movement of the telescope when centering Polaris in the telescope eyepiece or when using the polar alignment viewfinder (see ⓭ Fig. 1a).

⓬ **Latitude Dial**: Set the latitude of the observing site on this dial using the latitude T-handle screws. For more information see Step 4, page 10.

⓭ **Polar Alignment Viewfinder:** Allows you to precisely polar align the telescope. Useful when performing astrophotography. See page 31.

⓮ **Polar Alignment Viewfinder Reticle and LED Knob:** Rotate the knob to switch on or off the LED that illuminates the reticle within the polar alignment finder. Be sure to turn off the LED when finished with the polar viewfinder. Powered by (factory-supplied) batteries contained within.

⓯ **R.A. Setting Circle:** See **APPENDIX A,** page 29**,** for more information.

⓰ **R.A. Setting Circle Lock Knob:** Rotate the knob to lock the R.A. Setting Circle (see ⓯ Fig. 1a) in place.

⓱ **R.A. Lock**: Controls the manual movement of the telescope. Turning the R.A. lock counterclockwise unlocks the telescope enabling it to be freely rotated by hand about the R.A. axis. Turning the R.A. lock clockwise (to a firm feel only) tightens the lock and prevents the telescope from being moved manually, but engages the R.A. motor drive (see ❾ Fig. 1a) for Handbox operations.

⓲ **Dec. Motor Drive Assembly:** Controlled by the handbox. Moves the optical tube along the Dec. axis. The Dec. Lock (see ❶ Fig. 1a) must be tightened to a firm feel in order for the Dec. motor to operate.

⓬ *Want to learn more about **setting the latitude dials**?*
*See **STEP 4**, page 10.*

⓭ *Want to learn more about the **polar alignment viewfinder**?*
*See the **The Polar Alignment Viewfinder**, page 31.*

# The Handbox

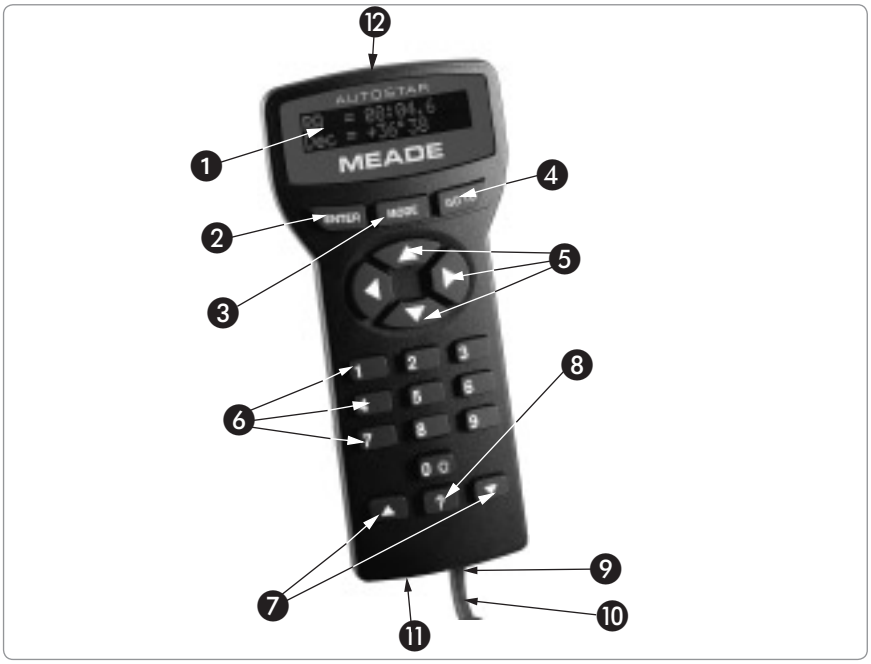



*Fig. 2: The handbox.*

***Note:*** *The handbox does not require batteries; the telescope's batteries supply power to the handbox.*

## Tour the Cosmos with Just the Push of a Button

Control of the telescope mount is through the operation of the handbox. Nearly all functions of the telescope are accomplished with just a few pushes of the buttons. Some of the major features of the handbox are:

- Automatic GO TO capability: Automatically move the telescope to any of the more than 30,000 objects stored in the object library.
- Take a guided tour of the best celestial objects to view on any given night of the year.
- Access a glossary of astronomical terms.
- Fully automatic tracking of celestial objects.

## Features

The Computer Controller provides control of virtually every telescope function within a compact handbox. The handbox has soft-touch keys designed to have a positive feel. The LCD (Liquid Crystal Display) is backlit with a red LED (Light Emitting Diode) for easy viewing in the dark. The backlit display, key arrangement, and sequential menu structure make the handbox extremely user friendly.

❶ **2-Line LCD Display:** This screen displays the menu structure and other information about the telescope.

- **Top line:** Lists the primary menu.
- **Bottom line:** Contains other menus that may be selected, menu options, telescope status, or information about a function that is currently being performed.

❷ **ENTER Key**: Press to go to the next menu level or to choose an option in a menu. The ENTER key is similar to the RETURN or ENTER key on a computer. See **MOVING THROUGH THE MENUS**, page 12 and **MENUS AND MENU OPTIONS.**

> ***Note:*** *If ENTER is pressed for two seconds or more and then released, the handbox emits a beep and "ENTER to Sync" is displayed. „ENTER to Sync" may be used only after your telescope has been aligned and is pointing at an object. See page 16 for more details.*

❸ **MODE Key**: Press to return to the previous menu level. The top menu level is "Select Item." The MODE key is similar to the ESCAPE key on a computer.

***Tip:***
*If the „ENTER to Sync“ feature is accessed by mistake, press MODE to return to the previous screen.*

❹ *Want to learn more about using the **GO TO function**? See page 16.*

*Want to learn how to perform a **spiral search**? See page 18.*

***Definitions:***
*„Slew“ means to move the telescope‘s optical tube to a selected object.*

***Note:** Pressing MODE repeatedly while in the “Select Item” level moves the handbox to the topmost screen: “Select Item: Object.”*

***Note**: If MODE is pressed and held for two seconds or more, information about the telescope‘s status displays. When the status displays, press the Scroll keys (**7, Fig. 2**) to display the following information and more:*

- *Right Ascension and Declination (astronomical) coordinates*
- *Altitude (vertical) and Azimuth (horizontal) coordinates*
- *Local Time and Local Sidereal Time (LST)*
- *Timer and Alarm Status*

*Press MODE again to return to the previous menu.*

❹ **GO TO Key**: Press to slew (move) the telescope to the coordinates of the currently selected object. While the telescope is slewing, the operation may be aborted at any time by pressing any key except GO TO. Pressing GO TO again resumes the slew to the object. Also, press GO TO after a slew is completed to activate a „spiral search.“

❺ **Arrow Keys**: Press to slew the telescope in a specific direction (up, down, left, and right), at any one of nine different speeds. See **SLEW SPEEDS**, page 9.

❻ **Number Keys:** Press to input digits 0 to 9. When data is not being entered, the Number keys can be used to change the slew speed. To operate, just press a number key (1 is the slowest speed, 9 is the highest speed). Press the Number key „0“ to turn on and off the red utility light on the top of the handbox.

❼ **Scroll Keys**: Press to access options within a selected menu. The menu is displayed on the first line of the screen. Options in that menu are displayed, one at a time, on the second line. Press the Scroll keys to move through the options. Press and hold a Scroll key to move quickly through the options.

❽ **? Key**: Press to access the „Help“ function. Help provides on-screen information on how to accomplish whatever task is currently active.

Hold down the ? key and then follow the prompts on the display to access details of the handbox functions in the Help feature. The Help system is essentially an on-screen instruction manual.

If you have a question about an handbox operation, *e.g.*, INITIALIZATION, ALIGNMENT, *etc.,* hold down the ? key and follow the directions that scroll on the second line. When satisfied with the Help provided, press MODE to return to the original screen and continue with the chosen procedure.

❾ **Coil Cord Port**: Plug one end of the coil cord (see ❿ Fig. 1a) into this port located at the bottom of the handbox and the other end into the HBX port of the computer control panel (**A, Fig. 1d**).

❿ **Coil Cord**: Plug one end of the coil cord into the HBX port (**A, Fig. 1d**) of the computer control panel of the telescope and the other end into the handbox coil cord port (See ❾ Fig. 1a).

⓫ **RS232 Port**: To connect a RS-232 cable to your computer to make data transfer possible such as “Download” or “Clone”.

⓬ **Utility Light**: Use this built-in red light to illuminate star charts and accessories without disturbing your eye‘s adaptation to darkness. Press „0“ to turn the light on and off.

# Telescope setup

## Balancing the telescope

In order for the telescope to be stable on the tripod and also for it to move smoothly, it must be balanced. To balance the telescope, unlock the Right Ascension or R.A. lock (**17, Fig. 1a**). When this axis is unlocked, the telescope pivots on the R.A. axis. Later in the procedure, you will also unlock the Declination or Dec. lock (**1, Fig. 1a)**. When unlocked, the telescope pivots on the Dec. axis. Most of the motion of the telescope takes place by moving about these two axes, separately or simultaneously. Try to become familiar with these locks and observe how the telescope moves on each axis. To obtain a fine balance of the telescope, follow the method below:

1. Firmly hold the optical tube secure so that it cannot accidentally swing freely. Loosen the R.A. lock (**17, Fig. 1a**). The optical tube now moves freely about the R.A. axis. Rotate the telescope so that the counterweight shaft (**6, Fig. 1a)** is parallel (horizontal) to the ground.

   REMARK!

   The LXD-75 mount comes with a 4,5 kg counterweight. In case that you do not suceed in balancing the mount., it could be necessary to use a second or third counterweight . Those are available as an optional accessory. Make sure however that a higher total weight affects stability of your complete setup negatively.
2. Unlock the counterweight lock knob and slide the counterweight (**5, Fig. 1a)** along the counterweight shaft until the telescope remains in one position without tending to drift down in either direction. Then re-tighten the counterweight lock knob, locking the counterweight in position.
3. Again, hold the optical tube so that it cannot accidentally swing freely. Lock the R.A. lock (**17, Fig. 1a**), and unlock the Dec. lock (**1, Fig. 1a)**. The telescope now is able to move freely about the Dec. axis. Loosen the cradle ring lock knobs so that the main tube slides easily back and forth in the cradle rings. Move the main tube in the cradle rings until the telescope remains in one position without tending to drift down in either direction. Re-lock the Dec. lock (**1, Fig. 1a)**.

The telescope is now properly balanced on both axes. Next, the viewfinder must be aligned.

## Observing by Moving the Telescope Manually

After the telescope is assembled and balanced as described previously, you are ready to begin manual observations. View easy-to-find terrestrial objects such as street signs or traffic lights to become accustomed to the functions and operations of the telescope. For the best results during observations, follow the suggestions below:

- When you wish to locate an object to observe, first loosen the telescope's R.A. lock (**17, Fig. 1a)** and Dec. lock (**1, Fig. 1a)**. The telescope can now turn freely on its axes. Unlock each axis separately and practice moving your telescope. Then practice with two unlocked axes at the same time. **It is very important to practice this step** to understand how your telescope moves, as the movement of an equatorial mount is not intuitive.
- Use the aligned viewfinder to sight-in on the object you wish to observe. When the object is centered in the viewfinder's crosshairs, re-tighten the R.A. and Dec. locks.
- A telescope's eyepiece magnifies 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. *For example*, an eyepiece with a focal length of 9mm has a higher magnification than an eyepiece with a focal length of 26mm.
  Low-power magnification eyepieces offer a wide field of view, bright, high-contrast images, and relief of eye strain during long observing sessions. To observe an object with a telescope, always start with a low power eyepiece such as the SP 26mm supplied with your telescope. When the object is centered and focused in the eyepiece, switch to a higher power eyepiece to enlarge the image as much as practical for prevailing viewing conditions.
- Once centered, an object can be focused by turning one of the knobs of the focusing mechanism. Notice that when observing astronomical objects, the

field of view begins to slowly drift across the eyepiece field. This motion is caused by the rotation of the Earth on its axis. Objects appear to move through the field more rapidly at higher powers. See **TRACKING OBJECTS,** page 10, for detailed information on how you can counteract the drift in the field of view.

## Activate the Arrow Keys

The arrow keys of the handbox allow you to slew (move) the telescope up, down, right, or left. The following procedure describes how to activate the arrow keys:

1. After the batteries are installed and the cord is plugged into the HBX port of computer control panel (**A, Fig 1d**), a copyright message lights on the handbox LCD display (**1, Fig. 2**).
2. A message warning not to look at the Sun scrolls across the display. Press the key prompted by the handbox to acknowledge that the Sun warning has been read and understood.
3. Press ENTER (**2, Fig. 2**) repeatedly until „Country/State“ appears on the display. (Ignore the prompts requesting Date and Time. See **INITIALIZING HANDBOX**, page 16, for more information).
4. Use the Scroll keys (**7, Fig. 2**) to cycle through the database of countries, states, and provinces. Press ENTER when the correct location displays.
5. The handbox then prompts you to enter the nearest city (listed alphabetically) to the observing site. Use the Scroll keys to cycle through the database of cities. Press ENTER when the correct city appears on the display.
6. The handbox then prompts you to enter the model number of your telescope. Use the Scroll keys to cycle through the list of telescope models. Press ENTER when the correct model appears on the display.
7. The display then reads „Align: Easy.“ You now can use handbox‘s Arrow keys to move the telescope to observe.

   ***Note:*** *If you go past the „Align: Easy“ (or any other menu display you wish to select), press MODE to return to the previous display(s).*

8. Press the Arrow keys (**5, Fig. 2**) to move the telescope up, down, right, or left. You can move the telescope at different speeds.

***Note:*** *The handbox only prompts you to enter Country (or State) and City as described in steps 3, 4, and 5, the first time it is activated. These prompts do not appear again, unless you reset the handbox (see **RESET**, page 24).*

*However, if you need to re-enter this information (e.g., you change your geographic location), you can change the location information by using the Site option of the Setup menu. See **ADDING OBSERVING SITES**, page 25, for detailed information.*

*The Site option „Zip code“ works for U.S. cities only. Users in Europe, please enter the „City“ option.*

## Slew Speeds

The handbox has nine slew speeds that move the optical tube at rates that are directly proportional to the sidereal rate and have been calculated to accomplish specific functions. Press a Number key (**6, Fig. 2**) to change the slew speed, which is shown for about two seconds on handbox’s display.

The nine available speeds are:

| | | | |
|---|---|---|---|
| Number Key 1 = | | | Guide (0.25 arc-min/sec or 0.004°/sec) |
| Number Key 2 = | 2x | = | 2 x sidereal (0.5 arc-min/sec or 0.008°/sec) |
| Number Key 3 = | 8x | = | 8 x sidereal (2 arc-min/sec or 0.033°/sec) |
| Number Key 4 = | 16x | = | 16 x sidereal (4 arc-min/sec or 0.067°/sec) |
| Number Key 5 = | 64x | = | 64 x sidereal (16 arc-min/sec or 0.27°/sec) |
| Number Key 6 = | 128x | = | 30 arc-min/sec or 0.5°/sec |
| Number Key 7 = | 1.5° | = | 90 arc-min/sec or 1.5°/sec |
| Number Key 8 = | 3° | = | 180 arc-min/sec or 3°/sec |
| Number Key 9 = | Max | = | 270 arc-min/sec or 4.5°/sec |

**Speeds 1, 2, or 3:** Best used for fine centering of an object in the field of view of a higher power eyepiece, such as a 12mm or a 9mm eyepiece.

**Speeds 4, 5, or 6:** Enables centering an object in the field of a low-to-moderate power eyepiece, such as the standard Super Plössl 26mm.

**Speeds 7 or 8:** Best used for rough centering of an object in the viewfinder.

**Speed 9:** Moves the telescope quickly from one point in the sky to another.

***Note:*** *If you wish to perform a more precise polar alignment for the purposes of astrophotography, see „Appendix B,“ page 31.*

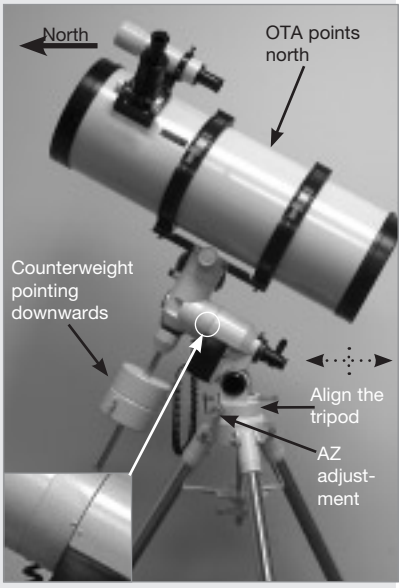



***Fig. 16a:*** *The polar home position, side view.* ***Inset:*** *Line up triangles on the mount.*

***Fig. 16b:*** *The polar home position, front view.*

## Observe the Moon

Point your telescope at the Moon (note that the Moon is not visible every night). Use the handbox to practice using the arrow keys and the slew speeds to view different features. The Moon contains many interesting features, including craters, mountain ranges, and fault lines. The best time to view the Moon is during its crescent or half phase. Sunlight strikes the Moon at an angle during these periods and adds a depth to the view. No shadows are seen during a full Moon, making the overly bright surface to appear flat and rather uninteresting. Consider the use of a neutral density Moon filter when observing the Moon. Not only does it cut down the Moon‘s bright glare, but it also enhances contrast, providing a more dramatic image.

## Tracking Objects

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. You can setup your telescope to move at the sidereal rate so that it automatically tracks the stars and other objects in the night sky. The tracking function automatically keeps an object more or less centered in the telescope’s eyepiece.

To automatically track objects, you first need to learn how to set the polar home position of your telescope and then how to select „Targets: Astronomical“ from the Handbox Setup menu.

## Setting the Polar Home Position

1. Level the mount, if necessary, by adjusting the length of the three tripod legs.
2. Unlock the R.A. Lock (**17, Fig. 1a**). Rotate the Optical Tube Assembly until the counterweight shaft is pointing straight down over the mount. See **Figs. 16a** and **16b.**
3. If you have not already done so, lift the telescope assembly and turn it so the tripod leg below the Fine Azimuth Control Knobs (**11, Fig. 1a**) approximately faces North (or South in the Southern Hemisphere). Release the Dec. lock (**1, Fig. 1a**) of the tripod, so that the optical tube may be rotated. Rotate the optical tube until it points North (or South in the Southern Hemisphere). Then re-tighten the lock. Locate Polaris, the North Star, if necessary, to use as an accurate reference for due North (or Sigma Octantis in the Southern Hemisphere). See **LOCATING THE CELESTIAL POLE**, page 30.
4. If you have not already done so, determine the latitude of your observing location. See **APPENDIX C: LATITUDE CHART**, page 41, for a list of latitudes of major cities around the world. Use the latitude T-handle screws (**10, Fig. 1a**) to tilt the telescope mount so that the pointer indicates the correct latitude of your viewing location on the latitude dial (**12**, **Fig. 1a**). See step 4, page 10 for more information.
5. If steps 1 through 4 above were performed with reasonable accuracy, your telescope is now sufficiently well-aligned to Polaris, the North Star, for you to begin making observations.

Once the mount has been placed in the polar home position as described above, the latitude angle need not be adjusted again, unless you move to a different geographical location (*i.e.*, a different latitude).

> ***Important Note:*** *For almost all astronomical observing requirements, approximate settings of the telescope’s latitude and other settings are acceptable. Do not allow undue attention to precise settings of polar home position of the telescope to interfere with your basic enjoyment of the instrument.*

## Observe a Star using the Automatic Tracking Feature

In this example, the arrow keys are used to find a star, and then the tracking capability automatically keeps the star centered in your telescope's eyepiece.

***Tip:***
*You can change the telescope's slew rate while centering an object in the eyepiece. See* ***SLEW SPEEDS****, page 9 for more information.*

***Important Note:*** *While performing the automatic tracking procedure, you may use the Arrow keys to move the telescope or you may also loosen the telescope locks (****1*** *and* ***17, Fig. 1a****) and move the optical tube manually to locate another object in the sky. The tracking function will continue to be operational and the telescope will track the new object.*

1. If you have activated the arrow keys and completed setting the telescope in the polar home position, the display now reads „Align: Easy." *Go to Step 2*.

   If you have not used the handbox yet or have just plugged it into the HBX port, *perform the procedures described in* ***ACTIVATE THE ARROW KEYS****, page 9 and* ***SETTING THE POLAR HOME POSITION****, page 10. Then go to Step 2 of this procedure.*

   If you have been using the handbox to perform other functions and the display does not read „Align: Easy," follow these steps:

   a. Press MODE (**3, Fig. 2**) repeatedly until „Select Item: Object" displays.
   b. Press the Scroll Up key (**7, Fig. 2**) once. „Select Item: Setup" displays.
   c. Press ENTER (**2, Fig. 2**). „Setup: Align" displays. *Go to Step 3*.
2. Press MODE (**3, Fig. 2**). „Setup: Align" displays.
3. Press the Scroll Down key repeatedly until „Setup: Targets" displays. Press ENTER (**2, Fig. 2**).
4. „Targets: Terrestrial" displays. Press one of the Scroll keys once (**7, Fig. 2**). „Targets: Astronomical" now displays.
5. Use the arrow keys (**5, Fig. 2**) to locate a bright star in the night sky. Use the viewfinder to help line up on the star. You may choose any unobstructed, bright star for the purposes of this example. Use the arrow keys to center the star in the eyepiece. Once the star is centered, press ENTER to select „Astronomical." The telescope's tracking motors then engage. It may take the tracking motors several seconds to begin tracking. When they do, it may be necessary to once again center the star in the eyepiece. The tracking motors will then keep any star you choose in the center of the eyepiece.
6. Press and hold the ENTER key for a few seconds and then release to stop tracking. You may also stop tracking by choosing „Terrestrial" in the Targets menu.

### Which One's the Alignment Star?

If the handbox has chosen an alignment star with which you are unfamiliar, how can you be sure if the star in your eyepiece is really the alignment star?

The rule of thumb is that an alignment star is usually the brightest star in that area of the sky. When you view an alignment star in an eyepiece, it stands out dramatically from the rest of the stars in that portion of the sky.

If you have an obstruction, such as a tree or a building blocking your view of the alignment star, or if you have any doubts at all about the star that has been chosen, no problem. Just press the Scroll Down key and the handbox will find another star to align upon.

***Tip:***
*When multiple choices are available within a menu option, the current option is usually displayed first and highlighted by a right pointing arrow (>).*

***Definition:***
***Initialization*** *is a procedure that ensures that the ahndbox operates correctly. When you first use the handbox, it doesn't yet know where the observation location site is or the time or date of the observation session.*

*You will enter information, such as the current time and date, and observation location.*

*The handbox uses this information to precisely calculate the location of celestial objects (such as stars and planets) and to automatically move your telescope correctly for various operations.*

## Using GO TO capabilities

Before you can use GO TO capabilities, you must first:

- Learn how the keys move through the menus
- Initialize the computer control
- Place the telescope in the polar home position, if you have not already done so (see **SETTING THE POLAR HOME POSITION,** page 10)
- Select „Align: Easy" from the menus

## Moving through the menus

The menus are organized for quick and easy navigation.

- Press ENTER (**2, Fig. 2**) to go deeper into menu levels.
- Press MODE (**3, Fig. 2**) to move back toward the top menu level.
- Press the Scroll keys (**7, Fig. 2**) to move up and down through the options available for each menu level.
- Press the arrow keys (**5, Fig. 2**) to enter characters.
- Press the number keys (**6, Fig. 2**) to enter digits.

## Initializing the handbox

This exercise describes how to initialize the handbox.

> ***Note:*** *Normally, you will enter the Time and Date at the beginning of each observing session, but you will only perform the full Initialization procedure (i.e., entering the Location information and selecting the model number as well as entering the Time and Date) the first time you use the handbox or after performing a Reset.*

1. Make sure that the telescope is assembled correctly, and that the batteries are installed as described previously.
2. Make sure the On/Off switch (**D, Fig. 1d**) is in the Off position. Plug the cord of the handbox into the HBX port (**A, Fig. 1d**), as previously described. Push the On/Off switch to the On position.
3. Press „0" to enter the Alignment menu after the copyright message disappeared.
4. The Getting Started menu displays a scrolling message with two choices:
   a. Press and hold down the ? key (**8, Fig. 2**) for about 2 seconds for information on the handbox functions and controls. When finished, press MODE (**3, Fig. 2**) to exit Help, or,
   b. Press ENTER (**2, Fig. 2**) to bypass the Help tutorial and continue with Initialization.
5. The handbox prompts you to enter the current date:
   a. Press the Numbers keys (**6, Fig. 2**) to enter numbers 0 through 9. After the desired number is displayed, use the Right Arrow key (**5, Fig. 2**) to move the cursor from one number to the next in the day display (or use the Left Arrow key to move in the other direction across the display, if necessary).
   b. Use the Right Arrow key (**5, Fig. 2**) to move the cursor to the month. Use the Scroll keys (**7, Fig. 2**) to cycle through the list of months. When the current month is displayed, use the Right Arrow (**5, Fig. 2**) to move the cursor to the year.
   c. Use Number keys (**6, Fig. 2**) to enter all four digits of the current year. Use the Right Arrow key (**5, Fig. 2**) to move the cursor from one number to the next.
   d. Press ENTER (**2, Fig. 2**) when the entire date has been entered.
6. The handbox then prompts you to enter the current time. Use the Number keys to enter digits. The Right and Left Arrow keys move the cursor across the screen as described in the previous step. Enter the current time (use a „0" for the first digit if less than 10). Use the Up Arrow key (**7, Fig. 2**) to scroll through „AM," „PM,'" or „blank." The „blank" option (screen displays neither AM nor PM) selects the 24-hour (*i.e.*, military time) clock. Then press ENTER to start the clock.
7. The handbox then prompts you to enter the status of Daylight Savings Time. Press one of the Scroll keys to toggle between the YES/NO settings. Select the desired setting by pressing ENTER.

> ***Note:*** *Daylight Savings Time may be referred to by a different name in various areas of the world.*

8. If you have previously entered the Country/State and City of your observing site (as described in **ACTIVATE THE ARROW KEYS**, page 9), *go to step 9*. If you have not entered this information, perform the following steps:
   a. The handbox prompts you to enter the Country or State (listed alphabetically) of the observing site. Use the Scroll keys to cycle through the database of countries, states, and provinces. Press ENTER when the correct location displays.
   b. The handbox then prompts you to enter the nearest city (listed alphabetically) to the observing site. Use the Scroll keys to cycle through the database of cities. Press ENTER when the correct city appears on screen.
9. The handbox then prompts you to enter the model number of your telescope. Use the Scroll keys to cycle through the list of telescope models. Press ENTER when the correct model appears on the display.

   ***Note:*** *The handbox only prompts you to enter Country/State and City and model number the first time it is activated. These prompts do not appear again, unless you reset the handbox (see **RESET,** page 24). However, if you need to enter this information (e.g., you change your geographic location), you can do so by using the Site option of the Setup menu. See **ADDING OBSERVING SITES**, page 25, for detailed information.*

10. System Initialization is complete and the display reads „Align: Easy.“ After performing the Initialization procedure, you MUST train your drive.

## Training the Drive

Next, train the drive using the handbox. Perform this procedure the first time you use the handbox with your telescope, after a Reset, or if you are experiencing any pointing accuracy problems. Training the drive gives your telescope a higher degree of pointing accuracy.

***Note:*** *Use a terrestrial object, such as a telephone pole or lamp post, to train the drive. It is best to perform this procedure during the daytime.*

1. If you have just performed ***INITIALIZING HANDBOX***, *go to step 2*.

   If you have not yet initialized the handbox, *go to page 12 and follow the procedure described in **INITIALIZING HANDBOX**.Then go to step 2 of this procedure*.
2. Keep pressing MODE until „Select Item: Object“ displays.
3. Press the Scroll Up key once. „Select: Item: Setup“ displays.
4. Press ENTER to access the Setup menu. „Setup: Align“ displays.
5. Keep pressing the Scroll Up key until „Setup: Telescope“ displays.
6. Press ENTER to access the Telescope menu. „Telescope: Focal Length“ displays.
7. Keep pressing the Scroll Down key until „Telescope: Train Drive“ displays.
8. Press ENTER to choose the Train Drive option. „Train Drive: Az/RA Train“ displays.
9. Press ENTER to begin Az/R.A. (Right Ascension) training.
10. „Drive Setup: For this....“ begins to scroll across the display. This is a reminder to point your telescope at a terrestrial object. Loosen the R.A. and Dec. locks (**1** and **17, Fig. 1a**) and point the telescope at an object. Then re-tighten the locks. Press ENTER when the telescope is pointing at the desired terrestrial object.
11. „Center reference object“ displays. Center your target object using the Arrow keys. When centered, press ENTER.
12. The telescope slews and „Press > until it is centered“ displays. Press the Right Arrow key until the target is centered again. Then press ENTER.

    ***Note:*** *If you pass the object when pressing the Arrow key, you cannot slew the telescope back in the other direction. Press MODE until „Train Drive: Az/RA Train“ displays and begin the procedure over again.*

13. The telescope slews and „Press < until it is centered“ displays. Press the Left Arrow key until the target is centered again. Then press ENTER.
14. „Train Drive: Az/RA Train“ displays again. Press the Scroll Down key and „Train Drive: Alt/Dec Train“ displays. Press ENTER to begin Alt/Dec. (Declination) training.
15. „Drive Setup: For this....“ begins to scroll across the display. This is another reminder to point your telescope at a terrestrial object. Loosen the R.A. and Dec.

locks (**1** and **17, Fig. 1d**) and point the telescope at an object. Then re-tighten the locks. Press ENTER when the telescope is pointing at the desired terrestrial object.

16. „Center reference object“ displays. Center your target object using the Arrow keys. When centered, press ENTER.
17. The telescope slews and „Press Λ until it is centered“ displays. Press the Up Arrow key until the target is centered again. Then press ENTER.
18. The telescope slews and „Press V until it is centered“ displays. Press the Down Arrow key until the target is centered again. Then press ENTER. „Train Drive: Alt/Dec Train“ displays again. You have now completed this procedure. Continue onto the next procedure, **EASY ALIGNMENT**.

***Note:*** *Three other alignment methods, One-Star, Two-Star and Three-Star Polar alignment, are available as options in the „Setup: Align“ menu. See page 30 and page 31 for more information.*

## Easy Alignment

After completing the „Train the Drive“ procedure, align your telescope using the handbox. The fastest and easiest way to start observing with Go To capabilities is to align your telescope using the Easy Alignment.

1. Keep pressing MODE until „Select Item: Setup“ is displayed. Press ENTER.
2. „Setup: Align“ displays. Press ENTER. „Align: Easy“ displays. Press ENTER.
3. „German North“ displays and a scrolling message prompts you to set your telescope in the polar home position. See **SETTING THE POLAR HOME POSITION**, page 10, for a description of this procedure. Press ENTER after you finish the procedure.
4. The handbox then chooses two stars from its database to align upon. When the telescope slews to the star for alignment, it may not appear in the field of view in the eyepiece. Use the Arrow keys to move the telescope until the star is visible and centered in the eyepiece. The alignment star should be easily recognized and be the brightest star in the area of the sky where the telescope is pointing. When the star is centered, press ENTER. Repeat the procedure for the second alignment star.

***Note:*** *The handbox locates alignment stars based on the date, time, and location entered. The alignment stars may change from night to night. All that is required is for the observer to center the selected star in the eyepiece when prompted.*

***Tip:***
*The GO TO key also allows you to perform a „spiral search.“ A spiral search is useful when the telescope slews to an object, but that object is not visible in the eyepiece after the telescope finishes its search. (This sometimes occurs during an alignment procedure.)*

*Press GO TO when the telescope stops slewing. The telescope begins to move in a spiral pattern at a very slow speed (you may change the slew speed if you wish—see **SLEW SPEEDS**, page 9) around the search area. Look through the eyepiece and when the object does become visible, press MODE to stop the spiral search. Then use the Arrow keys to center the object.*

## Go To Saturn

After performing the Train the Drive and the Easy Alignment procedures, the motor drive begins operating and the telescope is aligned for a night of viewing. Objects in the eyepiece should maintain (*i.e.*, track) their position even though the Earth is rotating beneath the stars.

***Important Note:*** *Once aligned, only use the menus or Arrow keys to move the telescope. Do not loosen the telescope locks, or move the base manually, or alignment will be lost.*

This exercise demonstrates how to select an object for viewing from the handbox's database, *i.e.*, Saturn. Note that Saturn is not visible all year long and it may be necessary for you to choose another object from handbox's database. However, the procedure will be identical to the one used for observing Saturn.

1. After the telescope is aligned, “Select Item: Object” displays. Press ENTER. If “Select Item: Object” is not currently displayed, press MODE repeatedly until it displays, then press ENTER.
2. “Object: Solar System” displays. Press ENTER.
3. “Solar System: Mercury” displays. Use the Scroll Down key until “Solar System: Saturn” displays.
4. Press ENTER. “Calculating” displays. Then “Saturn” and a set of coordinates displays. Saturn's (and other planets') coordinates change throughout the year.
5. Press GO TO. “Saturn: Slewing...” displays and the telescope slews until it finds Saturn. You may need to use the Arrow keys to center Saturn precisely in the eyepiece. The handbox then automatically slews (moves) the telescope so that it tracks Saturn (or whatever other object you may have chosen). Saturn remains centered in the eyepiece.

*Fig. 17: The planet Saturn is over 800 million miles from the Earth.*

## Using the Guided Tour

This example demonstrates using “Tonight’s Best” Guided Tour.

1. After observing Saturn, keep pressing MODE until “Select Item: Object” displays again.
2. Press the Scroll Down key twice. “Select Item: Guided Tour” displays.
3. Press ENTER. “Guided Tour: Tonight’s Best” displays. Press ENTER.

   ***Note:*** *If you wish to try out other Guided Tours, press the Scroll Down key to scroll through other tour choices. When the tour you wish to select displays, press ENTER.*
4. “Tonight’s Best: Searching...” displays. After calculating, “Tonight’s Best: Jupiter” displays.

   ***Note****: Different objects may be displayed on a tour list on any given night.*

   Press ENTER to display information about the object. Press GO TO to move the telescope to the object.
5. Press MODE to return to the Tour list. Press the Scroll keys to scroll through the list. Press ENTER when you find the next object you wish to observe.
6. Press and hold down MODE for two seconds to leave the Guided Tour menu.

# Basic Handbox operations

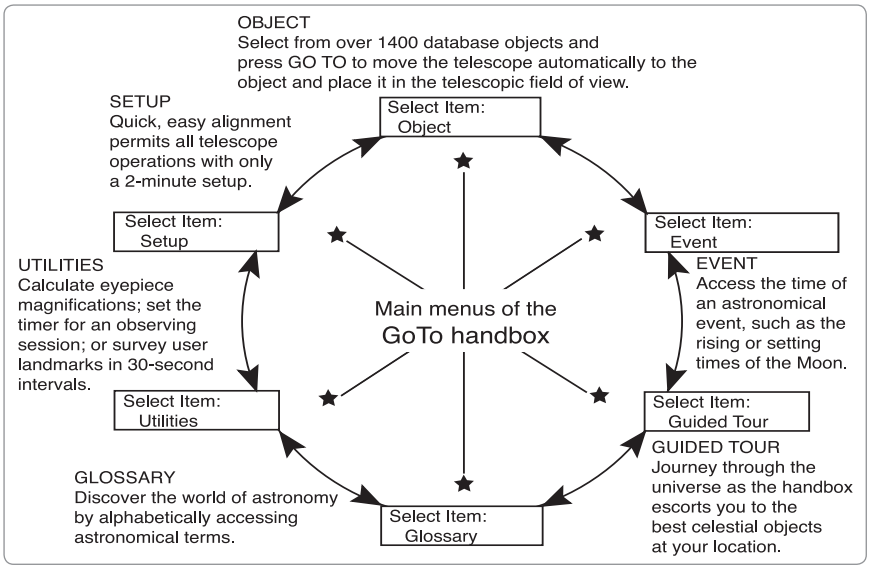



*Fig. 18: The handbox main menus.The six primary categories listed in the Select Item menu of the handbox.*

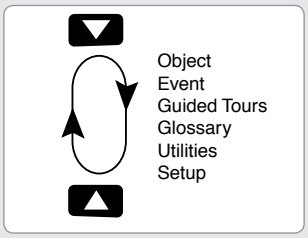



*Fig. 19: Menus set in a loop.*


*Fig. 20: Menu options display on the second line. Use the Scroll keys to move up or down through the list of options. Press ENTER to select the desired option.*

It is important to understand that menu selections are set in a loop (**Fig. 19**). This means that pressing the Scroll Down key (**7, Fig. 2**) cycles down through all the available options within a given category, then returns to the first option. The Scroll Up key (**7, Fig. 2**) cycles up through the options in the opposite order. Note that this capability is a quick way to get to an option that is near the bottom of the list. The following example demonstrates this capability.

***Example:***
To navigate to the “Select Item: Setup” menu option when the “Select Item: Object” menu is displayed:

1. Press the Scroll Down key five times or the Scroll Up key once.

The screen in **Fig. 20** displays two lines of information. The top line shows the current menu level. The second line displays an option which may be selected within that menu level. Some options are choices that select the next menu level down. The Scroll keys move up and down within the list of available options, showing one option at a time.

When the desired option is displayed on the second line, press the ENTER key to choose that option and move down one menu level.

Press the MODE key to leave a level; *e.g.*, the wrong menu option is chosen.

> ***Important Note:*** *No matter how many levels into the handbox are traveled, each press of the MODE key moves up a level, until the top level, „Select Item,“ is reached. Once in the Select Item level, press MODE to return to the topmost level, „Select Item: Object.“*

## Navigation Exercise

To demonstrate how the handbox menu structure works, the following exercise calculates Sunset time so an evening observing session can be planned.

> ***Note:*** *Before proceeding with this exercise, the handbox must be properly initialized and aligned (see pages 12 and 14).*

**To Calculate Sunset time:**

1. Press the MODE key several times, until “Select Item: Object” is displayed.
2. Press the Scroll Down key once to display the “Event” option in the “Select Item” menu.
3. Press the ENTER key to choose the „Event“ option and move down a level. „Event: Sunrise“ is displayed.
4. Press the Scroll Down key once to display the „Sunset“ option in the Event menu.

5. Press the ENTER key to choose the „Sunset“ option and move down another level.
6. The handbox calculates the Sunset time based on the current date, time, and location. The handbox then displays the results of the calculation.
7. Press MODE once to start moving back up through the handbox levels. The first level up is the Event menu.
8. Press MODE again to move up another level. This is the top level, „Select Item.“
9. Press MODE again to return to the starting point of „Select Item: Object.“

## Entering Data into the handbox

- Use the Number keys to enter digits.
- Use the Arrow keys to scroll through numbers 0 through 9 and the alphabet. The Down Arrow key begins with the letter „A;“ the Up Arrow key begins with digit „9.“
- To move the cursor across the display:
  Use the Right or Left Arrow key (**5, Fig. 2**) to move the cursor from one number to the next in the display.
- Press ENTER when the desired information has been entered.

***Tip:***
*When multiple choices are available within a menu option, the current option is usually displayed first and highlighted by a right pointing arrow (>).*

## Navigating through the handbox

Handbox‘s menus are organized for quick and easy navigation:

- Press ENTER (**2, Fig. 2**) to go deeper into handbox‘s menu levels.
- Press MODE (**3, Fig. 2**) to move back toward the top menu level.
- Press the Scroll keys (**7, Fig. 2**) to move up and down through the options or lists.
- Press the Arrow keys (**5, Fig. 2**) to move the cursor across the display.
- Press the Help (?) key (**8, Fig. 2**) to access on-line help.

# Handbox menus

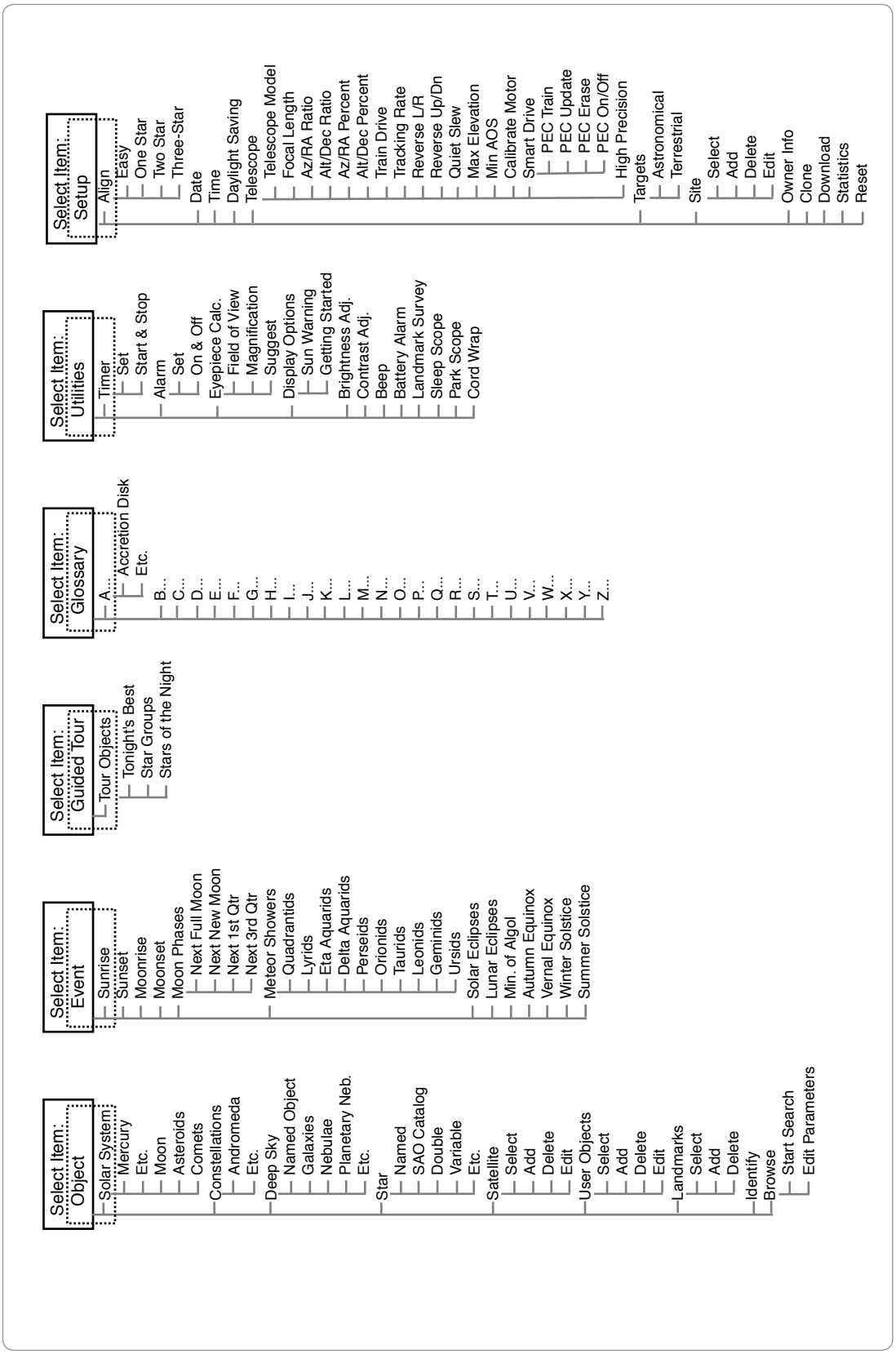



*Fig. 21 The Complete Handbox Menu Structure.*

# Menus

## Object Menu

Almost all observing with the handbox is performed using the Object menu category. (***Note:*** *Exceptions include Guided Tour and Landmark Survey.)* See **GO TO SATURN**, page 18, for an example of observing using the Object menu. Also see **USING THE GUIDED TOUR**, page 19.

The handbox contains many libraries of viewable objects, such as stars, planets, comets, nebulae and so forth. When one of these objects is selected from a library, the handbox moves your telescope (if properly aligned) and points it at the selected object.

The Object Menu options include:

**Solar System** is a library of the eight planets (Earth is not included) in order out from the Sun, followed by the Moon, asteroids, and comets.

**Constellation** is a library of all 88 Northern and Southern Hemisphere constellations. When this menu option is chosen and a constellation name appears on the first line of the screen, press GO TO once to change the second line to the name of the brightest star in the constellation. Press GO TO a second time to slew the telescope to that star. Use the Scroll keys to cycle through the list of stars in the constellation, from brightest to dimmest.

**Deep Sky** is a library of objects outside our Solar System such as nebulae, star clusters, galaxies, and quasars.

**Star** is a library of stars listed in different categories such as named, double, variable, or nearby.

*Want to learn more about **observing satellites?***

*See page 27.*

**Satellite** is a library of Earth-orbiting objects such as the International Space Station, the Hubble Space Telescope, Global Positioning System (GPS) satellites, and geosynchronous orbit satellites.

**User Objects** allows the user to define and store in memory deep-sky objects of specific interest that are not currently in the handbox libraries. See **Using the Handbox to Find Objects Not in the Libraries,** page 26 for more information.

*Want to learn more about **Landmarks?***

*See page 27.*

**Landmarks** stores the location of terrestrial points of interest in the permanent handbox database.

> ***Important Note:*** *To use the Landmark function, the telescope must be located and aligned exactly as when the landmark was added to the database.*

- **Select**: To select a Landmark already in the database (see **ADD** below), choose the „Select“ option and scroll through the list. Press ENTER to select a Landmark, then press GO TO and the telescope slews to the object.
- **Add**: To add a Landmark, choose the „Add“ option. Enter a name for the Landmark. Locate and center the Landmark in the eyepiece, then press ENTER.

**Identify** is an exciting feature for an observer who wants to scan the night sky and start exploring. After the telescope has been properly aligned, use the handbox Arrow keys to move about in the sky. Then follow this procedure:

> ***Important Note:*** *Only use the Arrow keys to move the telescope during the Identify procedure. Do not loosen the telescope locks or move the base or alignment is lost.*

1. When a desired object is visible in the eyepiece, keep pressing MODE until the “Select Item: Object” menu is displayed. Press ENTER to select this menu.
2. Scroll through the Object menu options until the “Object: Identify” screen appears.
3. Press ENTER. The handbox searches the libraries for the identity of the object being observed.
4. If the telescope is not directly on a handbox library object, the nearest library object is located and displayed on the screen. Press GO TO and the telescope slews to that object.

**Browse** allows you to search the library for objects with certain parameters, much like a search engine. „Edit Parameters“ lets you set various parameters for the

search, such as: Object Type, Minimum Elevation, Largest, *etc*. Once you have set the parameters of the search, select „Start Search“ and press ENTER. The handbox will display the results of the search.

## Event Menu

The Event menu provides access to dates and times of astronomical events. The Event database includes:

**Sunrise** and **Sunset** calculates the time that the Sun rises or sets on the current date. Find rise and set times for other dates by entering a new date into the “Setup: Date” menu.

**Moonrise** and **Moonset** calculates the time that the Moon rises or sets on the current date. Find rise and set times for other dates by entering a new date into the “Setup: Date” menu.

**Moon Phases** displays the date and time of the next Full, New, 1st Quarter, and 3rd Quarter Moon.

**Meteor Showers** provides information on upcoming meteor showers, such as the Perseids, the Leonids, *etc.* Also lists the dates of the showers and when they reach maximum.

> ***Note:*** *Meteors are fast moving objects that cover large areas of the sky and are usually best observed with the naked eye.*

**Solar Eclipse** lists upcoming Solar Eclipses, including the date and type (total, annular, or partial) of eclipse, and the location and time of the first and last contacts of the Moon‘s shadow. Use the Scroll Up and Down keys to display the available data. Remember, never use a telescope to look at the Sun! See **WARNING!** to the left.

**Lunar Eclipse** lists upcoming Lunar Eclipses, including the date and type (total, partial, penumbral) of eclipse. Use the Scroll Up and Down keys to display the available data.

**Min. (Minimum) of Algol** is the minimum brightness of the dramatic eclipsing binary star system, Algol. It is relatively close at a distance of 100 light years. Every 2.8 days during a 10-hour period, Algol undergoes a major change in apparent magnitude as one of the two stars passes behind the other. The combined magnitude of the two stars thus dips from +2.1 to a minimum of +3.4 halfway through the eclipse as the second star is hidden. The handbox calculates minimum magnitude time at mid-eclipse.

**Autumn** and **Vernal Equinox** calculates the time and date of the fall or spring equinox of the current year.

**Winter** and **Summer Solstice** calculates the time and date of the winter or summer solstice of the current year.

## Glossary Menu

The Glossary menu provides an alphabetical listing of definitions and descriptions for common astronomical terms and handbox functions. Access directly through the Glossary menu or through hypertext words embedded in the handbox. A *hypertext word* is any word in [**brackets**], usually found when using the handbox help function or when reading a scrolling message such as a description of a planet or star. Press ENTER whenever a hypertext word is on screen and the handbox goes to the glossary entry for that word.

To access directly from the Glossary menu, use the Scroll keys to scroll through the alphabet. Press ENTER on the desired letter. Scroll to the desired entry and then press ENTER to read the description.

## Utilities Menu

The Utilities menu provides access to several extra features within the handbox, including a countdown timer and an alarm. The Utilities functions include:

**Timer** selects a countdown timer. This feature is useful for functions such as astrophotography and tracking satellites. To use the Timer, press ENTER, then choose “Set” or “Start/Stop.“

- **Set**: Enter the time to be counted down, in hours, minutes, and seconds, then press ENTER.
- **Start/Stop**: Activates the timer set previously. Use the Scroll keys to toggle between ON and OFF. When ON is displayed, press ENTER to activate the

**WARNING! Never use a 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.**

timer. When the timer runs out, four beeps sound and the timer is deactivated.

**Alarm** selects a time for an alarm signal as a reminder. To use the Alarm, press ENTER, then choose „Set“ or „Start/Stop.“

- **Set**: Enter the time of day for the alarm to sound, in hours, minutes, and seconds, then press ENTER.
- **Start/Stop**: Activates the alarm set previously. Use the Scroll keys to toggle between on and off. When ON is displayed, press ENTER to activate the alarm. When the alarm time arrives, the handbox beeps. Press ENTER to deactivate the alarm.

**Eyepiece Calc** calculates information about an eyepiece for the specific telescope to which the handbox is connected.

- **Field of View:** Scroll through a list of available eyepieces. When an eyepiece is selected, the field of view is calculated.
- **Magnification:** Scroll through a list of available eyepieces. When an eyepiece is selected, the magnification is calculated.
- **Suggest:** The handbox calculates and suggests the best eyepiece for viewing, based on the telescope and the object being viewed.

**Display Options** enables or disables handbox's two initial displays. If both displays are disabled, the handbox begins with the Date display.

- **Sun Warning:** Turns the “Sun Warning” message on or off.
- **Getting Started:** Turns the “Getting Started” message on or off.

**Brightness Adj**: Adjusts the brightness of the display using the Scroll keys. When complete, press ENTER.

**Contrast Adj:** Adjusts the contrast of the display using the Scroll keys. When complete, press ENTER. The Contrast Adjustment feature is usually only required in very cold weather.

***Tip:***
*If you notice that the text is „smearing“ on the handbox display, use the contrast adjustment menu.*

**Beep:** Turns the beep on or off.

**Landmark Survey** automatically slews the telescope to all user-defined landmarks with a short pause at each location. Press ENTER to start the survey. While a slew is in progress, press any key to skip that object and go to the next landmark on the list. To observe a landmark for a longer period, press MODE when paused on the object to stop the survey. Press ENTER to restart the survey at the first object on the list.

*Want to learn more about **Landmarks**?*

*See page 27.*

**Sleep Scope** is a power saving option that shuts down the handbox and the telescope without forgetting its alignment. With „Sleep Scope“ selected, press ENTER to activate the Sleep function. The handbox goes dark, but the internal clock keeps running. Press any key, except ENTER, to re-activate the handbox and the telescope.

**Park Scope** is designed for a telescope that is not moved between observing sessions. Align the telescope one time, then use this function to park the telescope. Next time it is powered up, enter the correct date and time – no alignment is required. Pressing ENTER causes the telescope to move to its predetermined Park position. Once parked, the screen prompts to turn off power.

> ***Important Note:*** *When the „Park Scope“ option is chosen and the display prompts you to turn off the telescope's power, the handbox is unable to be returned to operation without turning the power off and then back on.*

**Cord Wrap** moves the telescope in such a way as to prevent the cords and cables attached to your telescope assembly from getting wound around the assembly and tangled as the telescope slews to objects. This menu is set to „On“ and cannot be changed by the user.

## Setup Menu

The Setup menu's primary functions are for setting up telescope alignment. However, there are numerous other features available within the Setup menu, including:

**Date** changes the date used by the handbox. This function is useful to check events in the past or future. For example, set the Date menu for a day three months in the future. Then check the „Select Item: Event" menu for the Sunset time on that date. See **EVENT MENU**, page 20.

**Time** changes the time entered into the handbox. Setting the correct time is critical for the handbox to properly calculate locations and events. Time may be set to 24-hour mode (military time) by selecting the „blank" option (*i.e.*, no option is displayed) which follows the „AM" and „PM" options.

**Daylight Saving** is used to enable or disable Daylight Savings time.

> ***Note**: Daylight Savings Time may be referred to by different names in various areas of the world. Check local time to verify.*

**Telescope** accesses several options, including:

- **Telescope Model:** Allows you to select the telescope model connected to the handbox.
- **Focal Length:** Displays the focal length of the selected telescope.
- **Az/R.A. Ratio and Alt/Dec. Ratio**: The Az (Azimuth) or the R.A. (Right Ascension) ratio and Alt (Altitude) or Dec. (Declination) ratio refers to the gears of the telescope's motors. Do not alter these numbers.
- **Az/R.A. Percent**: This option allows you to change the AZ (azimuth) or R.A. (right ascension) backlash, *i.e.,* the way the Arrow keys move the telescope along the azimuth or R.A. axes. If you enter a value near 100, the telescope tube responds more quickly (it responds immediately at 100%) as you hold down an Arrow key and also slews (moves) the tube more quickly. If you enter a value near 0, it takes longer for the tube to respond as you hold down an Arrow key and also slews the tube more slowly. Experiment with this option. Try changing the percent value until you get a „feel" for the Arrow keys that is comfortable for you.
- **Alt/Dec. Percent**: The option operates identical to the Az/R.A. Percent option (see above), but allows you to change the altitude or declination backlash, *i.e.,* the way the telescope responds to the Arrow keys when moving along the altitude or declination axes.
- **Train Drive**: Trains the Altitude/Declination and Azimuth/R.A. motors to locate objects with more precision.
- **Tracking Rate:** Changes the speed at which the telescope tracks targets in the sky.
  a. **Sidereal:** The default tracking setting for the handbox; sidereal rate is the standard rate at which stars move from East to West across the sky due to the rotation of the Earth.

### Observing Considerations

- Try to pick an observing site away from street and house lights and car headlights. While this is not always possible, the darker the site, the better.
- Give your eyes about ten minutes to adjust to the darkness before observing. Give your eyes a rest from observing every ten or fifteen minutes to relieve eyestrain.
- Try not to use a standard flashlight. A lot of observers use red LED flashlights or tape red cellophane over their flashlights to use for setup and map reading so they don't have to continually readjust their eyes to the darkness. Be careful not to shine bright lights if there are other observers in the area. Do not shine a flashlight into the telescope while someone is observing!
- Dress warmly. It gets chilly when you're sitting for prolonged periods.
- Practice setting up your equipment during the day or in a lighted area to become familiar with it before going to a dark site.
- Know your observing site. If you're going to try out an unfamiliar site, check it out in the daylight for possible obstructions and pitfalls.

*Tip:*
*The Reverse L/R and U/D functions are useful if you are observing in the Southern hemisphere.*

b. **Lunar:** Choose this option to properly track the Moon over long observing sessions.

c. **Custom**: Allows entry of user-defined tracking rates.

- **Reverse L/R:** Reverses the functions of the Left and Right Arrow keys (*i.e.*, the Right key moves the telescope to the left*).*
- **Reverse U/D:** Reverses the functions of the Up and Down Arrow keys (*i.e.*, the Up key moves the telescope down*).*
- **Quiet Slew**: Sets the maximum slew rate to 1.5° for quieter operation.
- **Max Elevation**: Allows you to enter a value in degrees that sets a limit as to how far the optical tube can swing upward during a programmed slew. (Note that it does not prevent you from performing a manual slew past this limit.) This is useful when you have a camera or other peripheral attached to the telescope — you can prevent it from striking the telescope base.
- **Min AOS (Acquisition of Signal):** Allows you enter a value in degrees. This value represents the altitude at which your telescope begins to slew when acquiring a satellite track. This is useful when you are observing satellites, but a tall tree or building is obstructing the telescope. For example, you might begin to track the satellite at 15° altitude, instead of 5°. See **OBSEVING SATELLITES**, page 34, for more information about satellites.
- **Calibrate Motor**: If the telescope motors appear to have a problem, use this option to retest the motors before performing a Reset. This option is also used if a handbox unit is moved between telescopes, to match the handbox to the new telescope. To calibrate the motors, select this option and press ENTER.

*Tip:*
*If the „ENTER to Sync“ feature is accessed by mistake (holding the ENTER key for more than 2 seconds), press MODE to return to the previous screen.*

- **Smart Drive:** Allows you to perform periodic error correction (PEC) on the R.A. drive worm gear. Must be performed with a high-power reticle (*eg.,* 9mm).
- **High Precision:** If High Precision is turned on, when looking for a faint celestial object (*i.e.*, a nebula or galaxy), handbox first slews to a nearby bright star and displays „ENTER to Sync.“ Center the star in the eyepiece, then press ENTER. At that point the telescope has a high precision alignment to that part of the sky and it then slews to the object that was originally requested.

**Targets** switches between Astronomical targets and Terrestrial targets. If „Astronomical“ is selected, the telescope tracking motor is activated and any object you observe will remain centered in the eyepiece. If „Terrestrial“ is selected, the tracking motor is turned off. To learn how to track an object automatically, see page 16.

**Site** provides access to several options including:

*Want to learn more about **adding and editing sites**? See page 25.*

- **Select**: Displays the currently selected observing site. Use the Scroll keys to cycle through all available sites (see **ADD** below). Press ENTER when the site you wish to select displays. Use this option when you move to a different geographic location.
- **Add**: Allows you to add new observing sites to the database (up to six sites may be stored). Scroll through the list of Countries/States. Press ENTER when the site you wish to add displays. Then choose the desired city in the same manner.
- **Delete**: Deletes a stored site from the database.
- **Edit**: Edits a selected site, including: the name, latitude, longitude, and time zone. Time Zone refers to the Greenwich Mean Time (GMT) time zone shift. Users West of Greenwich, England use “-” hours, East of Greenwich use “+” hours. For the United States, look up the time zone shift in **Table 1**.

  ***Note:*** *The handbox compensates for daylight savings time, if selected. See **SETUP MENU: DAYLIGHT SAVING**, page 22.*

| **Time Zone** | **Shift** |
|---|---|
| Universal-Time | 0 Hours |
| Central European Time | +1 Hour |
| Eastern European Time | + 2 Hours |

***Table 1:*** *Time Zone Shift.*

**Owner Info** accesses the owner information menu, including:

- **Name**: Users may enter both their first and last names using the Up and Down Arrow keys to cycle through the alphabet. Use the Right and Left Arrow keys to move through the text. Press ENTER when the entry is complete.

- **Address**: Use the Up and Down Arrow keys to enter your street address, city, state, and zip code. Press ENTER when the entry is complete.

**Download & Clone:** These are service menus for workshop purposes only.

**Statistics** provides basic statistical data about the handbox, including:

- **Characters Free**: Shows how much room is available in user-defined object memory.
- **Version**: Shows the current version of the handbox software.

**Reset** completely resets the handbox. Most values entered into the menus revert to factory defaults. The handbox requires initialization after a Reset before proceeding with observations. See **INITIALIZING THE HANDBOX,** page 22.

# For advanced users

Before trying out the examples in this section, familiarize yourself with the basic operations of the handbox described earlier in this manual. The following examples assume that you have a basic knowledge of the handbox and understand how to scroll to a desired menu or menu option, and how to enter numbers and text. It also assumes that you have initialized and aligned your telescope.

## Adding Observing Sites

If you plan to observe using the handbox at different geographic locations, you can store up to six observation sites in the handbox's memory to help simplify your telescope setup. Perform these procedures using the Site options (Add, Select, Delete, Edit) of the Setup menu.

**To Add a Site to the user-defined site list:**

In this example, you will choose a city and add it to the database list. You will then select the site to enable it.

1. Navigate to the „Setup: Site" menu. Press ENTER,
2. Scroll through the options until „Site: Add" displays. Press ENTER.
3. Scroll through the list of countries/states. Press ENTER when the country/state you wish to add displays.
4. Scroll through the list of cities. Press ENTER when the city you wish to add displays. The Site is now added to the database. You may add 5 sites using this method (the sixth site is the site you added during the manual initialization process).
5. To choose a site, navigate to „Setup: Select." Press ENTER. Scroll through the list of sites. When the desired site displays, press ENTER.

**To Edit a Site**

In this procedure, you will enter a location that is not available in the handbox database by editing data of a nearby site. You will edit the location's name, latitude. longitude and the time zone shift. You will then select the site to enable it.

You will need to know the latitude and longitude of your location to perform this procedure.

1. Using the Add option, choose a site on the list that is closest to your observing site and press ENTER so that the site is added to your observing sites list. Choosing a site already on the list (as opposed to using the „Custom" feature) makes it easier to edit, as the „Time Zone" value may not need to be changed.
2. Scroll to „Site: Edit" and press ENTER. „Edit: Name" displays. Press ENTER.
3. The name of the site you have just entered to your list displays; if it does not, scroll to the site.
4. Using the Arrow keys, change the name of the site so that it now reads the name of your observing location. Press ENTER. „Edit: Name" displays again.
5. Press the Scroll Down key and „Edit: Latitude" displays. Press ENTER.
6. Using the Number Keys, enter the latitude of your observing site and then press ENTER. „Edit: Latitude" displays again.
7. Press the Scroll Down key and „Edit: Longitude" displays. Press ENTER.
8. Using the Number Keys, enter the longitude of your observing site and then press ENTER. „Edit: Longitude" displays again.
9. Press the Scroll Down key and „Edit: Time Zone" displays. Press ENTER. (If the site you chose from the list in step 1 has the same Time Zone as the site you are editing, just press ENTER again to go on to the next step.) „Time Zone" refers to the Greenwich Time Zone shift. Users West of Greenwich, use „-" hours (one hour per time zone) and users East of Greenwich use „+" hours. For the United States, look up the shift in **TABLE 1,** at the left.
10. After entering the shift, press ENTER. „Edit Time Zone" displays.
11. Press MODE. „Site: Edit" displays.

| **Time Zone** | **Shift** |
|---|---|
| Universal-Time | 0 Hours |
| Central European Time | +1 Hour |
| Eastern European Time | +2 Hours |

***Table 1:*** *Time Zone Shift.*

12. Using the Arrow keys, scroll to „Site: Select.“ The site you have just edited displays. Press ENTER to select the site or press MODE to exit.

## Finding objects not listed in the libraries

In this procedure, you will enter coordinates of celestial objects that do not appear in any of the handbox libraries. You will enter the object‘s name and R.A. and Dec. coordinates (required information). You may also enter the object‘s magnitude and size (optional information).

Although the handbox contains an extensive database of celestial objects (stars, nebulae, planets, etc.) that you can observe, you may eventually want to view objects that are not part of a library. The handbox provides a feature that allows you to enter an object‘s R.A and Dec. coordinates in the „User: Objects“ option of the Object menu and allows automatic slewing of the telescope to the user-entered coordinates.

In order to use this menu option, you first need to look up the R.A. and Dec. coordinates of the object or objects you wish to observe. Check out your local library, computer store, or bookstore for astronomy books, CD Roms, or magazines (such as *Sky & Telescope* or *Astronomy),* to find coordinates of celestial objects. The objects/coordinates you enter become part of your own permanent database, called „User Objects.“

**To enter coordinates of an object into the „User: Objects“ option of the Object menu:**

1. Make sure the handbox has been initialized and the telescope has been aligned.
2. After the telescope is aligned, „Select Item: Object“ displays. (If necessary, use the Scroll keys to scroll through the menus, as previously described, to find this option.) Press ENTER.
3. „Object: Solar System“ displays. Keep pressing the Scroll Up key until „Object: User Object“ displays and press ENTER.
4. „User Object: Select“ displays. Press the Scroll Down key once. „User Object: Add“ displays. Press ENTER.
5. „Name“ displays on the top line and a blinking cursor on the second line. Use the Arrow keys, as previously described, to enter the name of the object you wish to add to the database. When you are finished, press ENTER.
6. „Right Asc.: 00.00.0“ displays. Use the Number keys to enter the digits for the Right Ascension coordinate of your object. When you are finished, press ENTER.
7. „Declination: +00°.00‘ „ displays. Use the Number keys to enter the digits for the Declination coordinate of your object. If necessary, use the Scroll Keys to change „+“ to „-.“ When you are finished, press ENTER.
8. The handbox then prompts you to enter the size of the object. This step is optional. Use the Number keys to enter the size (in arc-minutes), if so desired, and press ENTER to go to the next display. If you do not wish to enter this information, simply press ENTER.
9. The handbox then prompts you to enter the magnitude of the object. This step is also optional. Use the Number keys to enter this information, if so desired, and press ENTER to go to the next display. „User Object: Add“ displays again.

**To GO TO a user-entered object**

In this procedure, you will choose an object from the User Object list and GO TO the object.

1. With „User Object: Add“ displayed, press the Scroll Up key once. „User Object: Select“ displays. Press ENTER.
2. Use the Scroll keys (if necessary) to scroll to the desired object. Press ENTER.
3. The name of the object and the Right Ascension and Declination coordinates display.
4. Press GO TO and the telescope slews to the object.

***Tip:***
***Entering R.A. and Dec. Coordinates of an object without using the menus:***
*If you do not wish to navigate through the menus, a more direct way to enter coordinates is to press and hold MODE for two seconds or more. R.A. and Dec. coordinates display. Press GO TO. „Object Position“ and a set of coordinates displays. Enter the R.A. and Dec. coordinates of any celestial object using Number keys, overwriting the coordinates currently displayed. As soon as the coordinates are entered, the handbox slews the telescope to the coordinates. Note that the telescope must be initialized (see page 16), placed in the Home position (see page 14), and aligned (see page 18) for this procedure to operate properly.*

*However, if you wish to store the coordinates of an object in memory, use the method described at the right.*

## Observing Satellites

In this procedure, you will prepare your telescope to observe a satellite pass.

1. Navigate to the „Object: Satellite“ menu option and press ENTER.
2. Use the Scroll keys to scroll through the list of satellites.
3. Select a satellite from the list and press ENTER.
4. „Calculating....“ and then „Tracking...“ displays. If the satellite is going to make a pass, „Located“ displays.
5. Use the Scroll keys to display data about the pass: aos – acquisition of signal and los – loss of signal. If you subtract the aos from the los, you can calculate how long the satellite will be visible. Location information also displays.
6. „Alarm“ displays after the location information. Press ENTER and the handbox automatically sets the alarm to sound a minute before the satellite‘s scheduled appearance. You may return to regular observations until the alarm goes off.
7. When the alarm goes off, return to the Satellite menu and press a Scroll key until the desired satellite is on the top line of the display.
8. Press GO TO. The handbox slews the telescope to where the satellite should appear. The motor drive stops and a countdown is displayed.

   ***Note:*** *If the scheduled appearance position of the satellite is obstructed (i.e., by a building, tree, or hill), press ENTER and the handbox starts to move the telescope along the expected satellite track. When the track clears the obstruction, press ENTER again to pause the telescope, then continue with this procedure.*

9. With about 20 seconds left on the countdown timer, start watching through the telescope viewfinder for the satellite to enter the field of view.
10. When the satellite enters the viewfinder field of view, press ENTER. The telescope starts to track with the satellite.
11. Use the handbox Arrow keys to center the object in the viewfinder, then look through the eyepiece to view the object.

Satellite orbits change and new satellites (including the Space Shuttle) are launched. If orbital parameters are more than one month old, the satellite pass may not happen at the time predicted by the handbox. Information about oribital elements is provided e.g. at www.heavens-above.com

***Note:*** *Satellite observing is an exciting challenge. Most satellites are in low orbit, travelling at approximately 17,500 mph. When visible, they move quickly across the sky and are only in the field of view for a few minutes, requiring the handbox to slew the telescope rapidly. Best viewing is near Sunrise or Sunset when the sky is still dark. Viewing in the middle of the night can be problematic because the satellite may pass overhead, but not be visible as it is in the Earth‘s shadow.*

***Tip:***
*To use the Landmark function, the telescope must be located and aligned exactly as when the landmark(s) was added to the database.*

## Landmarks

This menu option allows you to define and store terrestrial objects in the Landmark database. First, a landmark needs to be stored in memory using the „Landmark: Add“ option. To view a landmark, use the „Landmark: Select“ option. Landmarks may also be viewed using the „Landmark Survey“ option in the Utilities menu.

**To Add a landmark to the database:**
In this procedure, you will store the location of terrestrial landmarks in handbox‘s memory.

1. Note for future reference where the telescope is located. Select an easily recognizable reference object and center the object in the telescope eyepiece. Each time you wish to view landmarks you have added to the database, setup the telescope in this location and center the reference object in the eyepiece. If you do not use a consistent point of reference, the telescope will not be able to locate the objects you have added to the database.

   Another setup method is to select an object from the Landmark database. See **TO SELECT A LANDMARK FROM THE DATABASE** below**.** Then manually

move the telescope's optical tube and center this object in the telescope eyepiece.

2. Display the „Setup: Targets“ menu option. Choose „Terrestrial“ and press ENTER. „Setup: Targets“ displays again. Choosing this option turns off tracking for astronomical objects which is not useful for the viewing of terrestrial objects such as those in the Landmark database. Be sure to change this option back to „Astronomical“ when you wish to view celestial objects again.
3. Press MODE once. „Select Item: Setup“ displays.
4. Press the Scroll Down key once and „Select Item: Object“ displays. Press ENTER. „Object: Solar System“ displays.
5. Press the Scroll Up key twice and „Object: Landmarks“ displays. Press ENTER. „Landmark: Select“ displays.
6. Press the Scroll Down key once. „Landmark: Add“ displays. Press ENTER.
7. „Landmark Name“ displays. Using Arrow keys, enter a name for the landmark you wish to add to the database. When finished, press ENTER.
8. „Center Landmark. Press Enter“ displays. Using only the Arrow keys (do not manually move the telescope), move the telescope to the desired landmark and center the object in the eyepiece. Press ENTER. The object is now stored in memory.
9. „Landmark: Add“ displays. If you wish to add more landmarks, repeat steps 5 through 7.

**To Select a landmark from the database**

1. Make sure the telescope is located and aligned exactly as when the desired landmark was entered into memory.
2. Display the „Landmark: Select“ menu option. Press ENTER.
3. Use the Scroll keys to scroll through the list of objects you have previously entered. When the desired object displays, press ENTER to select the object.

   Use the Scroll keys to scroll through location information about the object, if desired. Press GO TO to slew the telescope to the landmark.
4. Press MODE to exit.

**To perform a Landmark Survey**

This procedure allows you to perform a tour of the objects entered in the „Object: Landmark“ menu option — note that the Landmark Survey will function only if you have previously entered objects in the Landmark menu.

1. Navigate to the „Utilities: Landmark Survey“ menu and press ENTER.
2. „Landmark Survey: Slewing...“ displays. The telescope moves to the first object on the Survey list and displays the name of the object.
3. Press MODE to pause the Survey. Press ENTER to restart the survey at the first object of the survey.

## To Check on the Available Memory

The handbox has a limited amount of memory. Once you begin to store Landmarks, user objects and other bits of information in the handbox, you will begin to use up memory. This procedure allows you to check on how much memory is still available.

1. Navigate to the „Setup: Statistics“ menu option and press ENTER.
2. „Statistics: 37.2K Char. Free“ displays. This is the amount of memory that is still available to the user.

# Appendix A: Celestial coordinates

A celestial coordinate system was created that maps an imaginary sphere surrounding the Earth upon which all stars appear to be placed. This mapping system is similar to the system of latitude and longitude on Earth surface maps.

In mapping the surface of the Earth, lines of longitude are drawn between the North and South Poles and lines of latitude are drawn in an East-West direction, parallel to the Earth's equator. Similarly, imaginary lines have been drawn to form a latitude and longitude grid for the celestial sphere. These lines are known as **Right Ascension** and **Declination**.

The celestial map also contains two poles and an equator just like a map of the Earth. The poles of this coordinate system are defined as those two points where the Earth's north and south poles (*i.e.,* the Earth's axis), if extended to infinity, would cross the celestial sphere. Thus, the North Celestial Pole (**1, Fig. 41**) is that point in the sky where an extension of the North Pole intersects the celestial sphere. The North Star, Polaris is located very near the North Celestial Pole. The celestial equator (**2, Fig. 41**) is a projection of the Earth's equator onto the celestial sphere.

Just as an object's position on the Earth's surface can be located by its latitude and longitude, celestial objects may also be located using Right Ascension and Declination. For example, you could locate Los Angeles, California, by its latitude (+34°) and longitude (118°). Similarly, you could locate the Ring Nebula (M57) by its Right Ascension (18hr) and its Declination (+33°).

- **Right Ascension (R.A.):** This celestial version of longitude is measured in units of hours (hr), minutes (min), and seconds (sec) on a 24-hour „clock" (similar to how Earth's time zones are determined by longitude lines). The „zero" line was arbitrarily chosen to pass through the constellation Pegasus — a sort of cosmic Greenwich meridian. R.A. coordinates range from 0hr 0min 0sec to 23hr 59min 59sec. 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 zero R.A. grid line (0hr 0min 0sec) carry higher R.A. coordinates.
- **Declination (Dec.):** This celestial version of latitude is measured in degrees, arc-minutes, and arc-seconds (*e.g.,* 15° 27' 33"). Dec. locations north of the celestial equator are indicated with a plus (+) sign (*e.g.,* the Dec. of the North celestial pole is +90°). Dec. locations south of the celestial equator are indicated with a minus (–) sign (*e.g.*, the Dec. of the South celestial pole is –90°). Any point on the celestial equator (such as the the constellations of Orion, Virgo, and Aquarius) is said to have a Declination of zero, shown as 0° 0' 0."

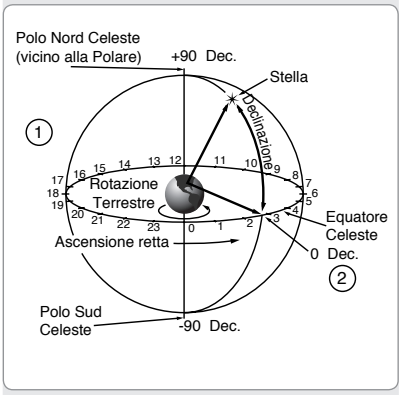



*Fig. 41: Celestial Sphere.*

## Setting Circles

Setting circles included with the LXD™75 Newtonians permit the location of faint celestial objects not easily found by direct visual observation. With the telescope pointed at the North Celestial Pole, the Dec. circle (**3, Fig. 1a**) should read 90° (understood to mean +90°). Each division of the Dec. circle represents a 1° increment. The R.A. circle (**15, Fig. 1a**) runs from $0^{hr}$ to (but not including) $24^{hr}$, and reads in increments of $5^{min}$.

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.

> ***Note*** *You may also enter an object's R.A. and Dec. coordinates using the „User: Objects" option of handbox's Object menu. The handbox then automatically slews the telescope to the entered coordinates.*

**To use the setting circles to locate an object not easily found by direct visual observation:**

Insert a low-power eyepiece, such as a 26mm, into the focuser assembly. Pick out a bright star with which you are familiar (or is easily located) that is in the area of the sky in which your target object is located. Look up the R.A. coordinate of the bright star, and also of the object you wish to locate, in a star atlas. Point

the object at the bright star. Then loosen the R.A. setting circle lock knob (**16, Fig. 1a**) and turn the R.A. setting circle to read the correct R.A. coordinate of the bright star; lock the R.A. setting circle lock knob onto the object. Next, loosen the R.A. lock (**17, Fig. 1a**) and turn the telescope in R.A. to read the correct R.A. coordinate of the object. Tighten the R.A. lock (**17, Fig. 1a**). If the procedure has been followed carefully, the desired object should now be in the telescopic field of a low-power eyepiece.

If you do not immediately see the object you are seeking, try searching the adjacent sky area. Keep in mind that, with the 26mm eyepiece, the field of view of is about 0.5°. Because of its much wider field, the viewfinder may be of significant assistance in locating and centering objects, after the setting circles have been used to locate the approximate position of the object.

See **FIND OBJECTS NOT LISTED IN THE LIBARIES,** page 26, for information on how to manually enter coordinates into the handbox.

## 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. 42***).*

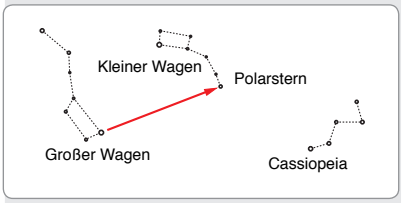



*Fig. 42 Locating Polaris.*

## Polar Alignment

The handbox provides several different methods of Polar Alignment: Easy, One-Star, Two-Star and Three-Star. See **EASY ALIGNMENT**, page 14, and **THREE-STAR ALIGNMENT USING THE HANDBOX**, page 31, for those procedure.

## One-Star Polar Alignment

Polar One-Star Alignment requires some knowledge of the night sky. The handbox provides a library of bright stars and one star from this library is chosen by the observer for alignment. Polaris is chosen by the handbox. The rest of the procedure is almost identical to the **EASY ALIGNMENT**, page 14, except that the handbox prompts you to point the telescope at Polaris and center it in the telescope‘s eyepiece.

## Two-Star Polar Alignment

Polar Two-Star Alignment requires some knowledge of the night sky. The handbox provides a library of bright stars and two stars from this library are chosen by the observer for alignment. Polaris is chosen by the handbox. The rest of the procedure is almost identical to the **EASY ALIGNMENT**, page 14, except that the handbox prompts you to point the telescope at Polaris and center it in the telescope‘s eyepiece.

# Appendix B:
# Enhancing Pointing Precision

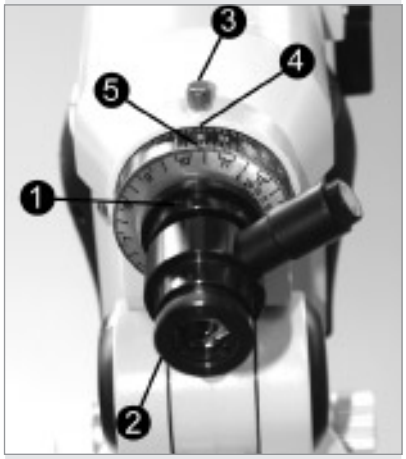



*Fig. 43a: The polar alignment viewfinder.*

*Fig. 43b: The view inside the polar alignment viewfinder reticle.*

## The Polar Alignment Viewfinder

Typically handbox's pointing capabilities are sufficient for most telescope observers, and the use of the polar alignment viewfinder is unnecessary for them. However, for those observers who need to meet the more demanding requirements of astrophotography, the polar alignment viewfinder allows the telescope mount to be more precisely aligned with true North. The polar alignment viewfinder contains a reticle, lit by an LED (**Figs. 43a** and **43b**).

**To align your telescope to North using the polar alignment viewfinder:**

1. Set your telescope in the home position (see page 15). Then loosen the Dec. lock (**1, Fig. 1a**) and rotate the optical tube 90°. Re-tighten the Dec. Lock.
2. Loosen the R.A. Lock (**17, Fig. 1a**).
3. Remove the polar viewfinder cap (**2, Fig. 1a**).
4. If you have not already done so, remove the plastic separating the watch batteries inside the polar alignment reticle. See step 11, page 11.
5. Turn the polar alignment reticle LED knob to turn on the LED and look through the reticle.
6. **Northern Hemisphere:** Move the telescope mount until Polaris is superimposed on the graduated area of the reticle (between 40' and 60'). The center crosshair denotes the North celestial pole. **Southern Hemisphere:** The four-sided figure in the reticle represents a grouping of four stars in Octantis (Sigma, Tau, Chi, and Upsilon) for use in the Southern Hemisphere. Move the telescope mount on its R.A. axis until the four stars depicted in the reticle are superimposed on the four star group that matches the reticle pattern.
7. Use the latitude T-handle screws (**10, Fig. 1a**) and the fine azimuth control knobs (**11, Fig. 1a**) to fine tune the mount adjustment until the reticle pattern is more precisely superimposed over the appropriate position as described in step 6.

   ***Note:*** *Not all pointing positions are possible with the polar alignment reticle, as the tripod is a limiting factor as to how far the optical tube and mount can be moved.*
8. Tighten the R.A. Lock (**17, Fig. 1a**). Return the optical tube to the home position.

   ***Note:*** *Remember to turn off the polar alignment reticle LED.*

## Enhancement Methods

The handbox provides four methods of enhancing your telescope's pointing precision:

#1: Three-Star Alignment and
#2: Axis Alignment and #3 for Axis Alignment with the handbox.

Method #1 is recommended for all users, but especially for the beginner and Methods #2 and #3 are recommended for the Advanced observer.

## Method #1: Three-Star Alignment Using the handbox

Perform this procedure at night. This method is similar to Two-Star Alignment (see page 35), but in this method, the handbox chooses three stars to align upon: Two stars on one side of the sky and a third star on the opposite side of the sky.

In order to get the most out of this procedure, make sure you perform the Train the Drive procedure (see page 17). The combination of Training your Drive and performing Three-Star Alignment will optimize your pointing accuracy.

**To perform the Three-Star Alignment:**

1. Keep pressing MODE until „Select Item: Setup" is displayed. Press ENTER.
2. „Setup: Align" displays. Press ENTER. „Align: Easy" displays. Press the Scroll Down key until "Align: Three-Star" displays. Press ENTER.
3. „German North" displays and a scrolling message prompts you to set your telescope in the polar home position. See SETTING THE POLAR HOME POSITION, page 14, for a description of this procedure. Press ENTER after you finish the procedure.

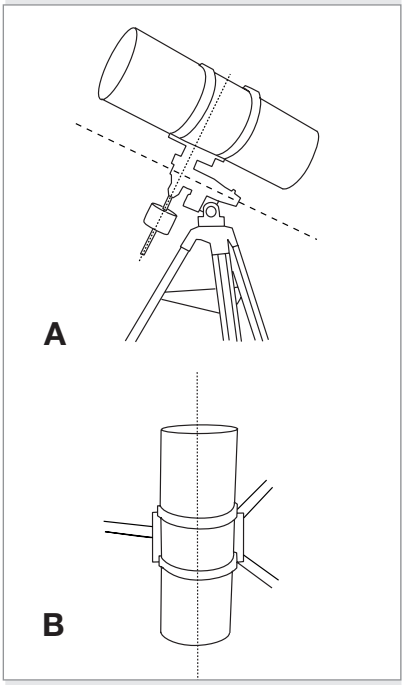



*Fig. 44: A. Elevation Alignment; B. Attitude Alignment.*

4. The handbox then chooses three stars from its database to align upon. When the telescope slews to a star for alignment, it may not appear in the field of view in the eyepiece. Use the Arrow keys to move the telescope until the star is visible and centered in the eyepiece. The alignment star should be easily recognized and be the brightest star in the area of the sky where the telescope is pointing. See **WHICH ONE'S THE ALIGNMENT STAR**, page 13, for more information. When the star is centered, press ENTER. Repeat the procedure for the second and third alignment stars.

***Note:*** *The handbox locates alignment stars based on the date, time, and location entered. The alignment stars may change from night to night. All that is required is for the observer to center the selected star in the eyepiece when prompted.*

## Method #2: Axis Alignment Procedures

In order for the equatorial mount to accurately point to astronomical objects using the GO TO feature of the handbox, the optical axis of the optical tube must be aligned with the R.A. axis of the mount. In most cases, the telescope will perform adequately without making any adjustments, but performing one of the following alignment methods before the initial use of the telescope, and periodically thereafter, will increase the mount's pointing accuracy.

When the optical axis is perfectly aligned to the R.A. axis and the declination set to 90°, all objects will rotate about a point in the center of the eyepiece, as the mount is rotated about the R.A. axis. A misalignment in elevation results in the center of rotation shifting up or down. A misalignment in attitude results in the center shifting left or right.

The telescope is moved manually in Method #1 to correct for attitude misalignment and then for elevation misalignment. The handbox moves the telescope in Method #2.

**Procedure #1: To correct for attitude misalignment**

***Important Note:*** *Throughout the following procedures, the directional references up/down/left/right are used. No matter which type of telescope model you are using, these directions are to be interpreted relative to real-world targets. For example, left/right moves the image along the horizon, and up/down moves the image vertically.*

Perform this procedure during the daytime. You will need to have a clear line of sight to a wide, distinct landmark with a clear, horizontal feature.

1. Plug in the handbox and turn on the power as described previously in this manual. You will use handbox's Arrow keys in the course of this procedure.
2. Loosen the R.A. Lock (**17, Fig. 1a**) and the Dec. Lock (**1, Fig. 1a)**. Point the tube so that the tripod leg below the Fine Azimuth Control Knobs (**11, Fig. 1a**) approximately faces North (or South in the Southern Hemisphere). Retighten the Dec. Lock. Move the counterweight shaft and mount so that it is parallel to the horizon. This is position A. See **Fig. 45**. Retighten the R.A. Lock.
3. **R**otate the optical tube (you will need to loosen the cradle ring lock knobs to do so) to make sure the focuser extends horizontally from the optical tube while in position A and do not rotate the tube for the remainder of the alignment procedure.
4. Adjust the tripod legs, polar axis altitude and/or polar axis azimuth so that the wide, horizontal object you have chosen as a target is positioned across the middle of the eyepiece.


*Procedure #1: Step 4*


*Step 5*


*Step 6*


*Step 7*

*Fig. 45: Position A.*

*Fig. 46: Position B.*

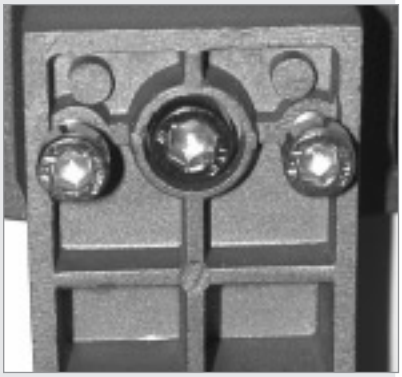


*Fig. 47: Cradle adjustment screws.*

***Important Note:*** *The image will appear upside-down, but correct left-for-right, in the eyepiece of a* ***Newtonian telescope****, if the eyepiece extends horizontally from the tube, as described in Step #3.*

5. Loosen the R.A. Lock (**Tip:** Make sure you do not accidentally loosen the Dec. Lock. If you do, restart the procedure beginning at Step #2). Rotate the telescope 180° in the R.A. axis ONLY, until the optical tube is in position B. See **Fig. 46**. Note the position of your target in the eyepiece.
6. Using the the handbox Up and Down Arrow keys ONLY, move the optical tube in Dec. axis until your target is HALFWAY back to the center of the eyepiece.
7. Rotate the telescope 180° in the R.A. axis ONLY, to return the optical tube to position A. Verify that your target is in the same location in the eyepiece vertically as in the previous step (that is, it is not higher or lower or absent from the eyepiece). Ignore side-to-side misalignment (that is, if it has moved to the right or left).
8. Repeat steps 6 and 7, if necessary, alternating positions A and B, until the horizontal object is in the same vertical location in the eyepiece in both positions.
9. The Dec. optical axis is now calibrated to be at 90 degrees. For Procedure #2, DO NOT adjust the declination of the optical tube, either manually or with the handbox.

**Procedure #2: To correct for elevation misalignment**

After performing the attitude correction, select an object that is at a very great distance (at least a mile away) to approximate infinity. Ideally, the object should be unique, with several identifiable objects to the left and right of it.

1. Rotate the mount about the R.A. axis only and move the optical tube to position A.
2. WITHOUT moving the declination axis from its position determined in the previous alignment, adjust the legs, latitude, and azimuth of the tripod to center the object in the eyepiece.

*Procedure #2: Step 2*

*Step 4*

*Step 5*

*Step 6*

3. Rotate the telescope 180° in the R.A. axis ONLY, until optical tube is in position B.
4. Observe the position of the object in the eyepiece. Assuming that the declination was properly set in the previous procedure, the object should have moved only horizontally (that is, side-to-side) from its original position. It may be out of the eyepiece altogether.
5. Using the adjustment mechanism on the bottom of the cradle (**Fig. 47**), move the reference object approximately half the distance towards the center of the eyepiece.

   To adjust the cradle screws, use the supplied hex key to loosen the two outside screws. Then adjust the position of the object by tightening or loosening the center screw. Perform this adjustment on both sets of screws. When finished, retighten the outer screws.

   Before moving the optical tube, note the location that the telescope is centered on relative to the reference object. Depending on the telescope type and accessories in use, you may need to move the optical tube opposite to the direction that appears in the eyepiece. The best way to be sure is to move the optical tube (using the cradle screws) a little, and verify that the correct direction was moved through the eyepiece.
6. WITHOUT moving the declination axis from its position determined in the previous alignment, and WITHOUT adjusting the cradle position further, adjust the legs, latitude, and azimuth of the tripod to center the object in the eyepiece again.

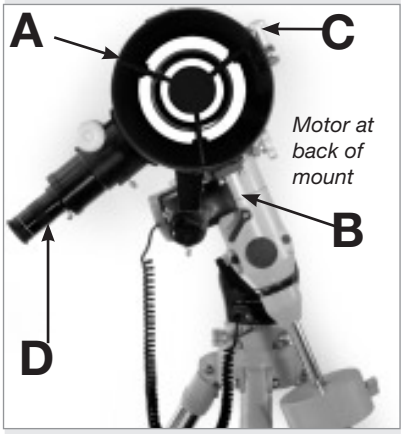



*Fig. 48: Method #2 Setup. (A) Optical Tube; (B) Dec. Motor; (C) Cradle Ring Lock Knobs; (D) Eyepiece.*

7. Rotate the telescope 180° in the R.A. axis ONLY, to return the optical tube to position A.
8. Repeat steps 5 through 8, if necessary, alternating between position A and position B, and bringing the reference object halfway of the remaining distance to center. Stop the procedure once the distance between the object in position A and position B is less than one third the width of the eyepiece.
9. As a final check, select another object and place it into the center of the eyepiece. Rotate the mount about the R.A. axis. Watch the motion of that object. It is acceptable if it moves slightly, but should remain in the eyepiece the entire time.

**Tips**

- When moving to position A or B, it is usually sufficient to merely level the Dec. axis by eye. Whether in position A or B, the counterweight shaft should appear to be horizontal when looked at from several feet away.
- If you are finding it difficult to lower the altitude of the tripod head without the counterweight banging into the forward tripod leg, increase the length of the two rear tripod legs to introduce a tilt into the whole mount.
- Before starting the alignment procedure, it is helpful to have the tripod azimuth adjustment knobs even, to allow an equal range of travel in either direction.
- Make sure the focuser lock is tightened once focus is achieved. Otherwise, gravity may cause the focuser to move during rotation of the telescope and introduce error into the procedure.

## Method #3: Axis Alignment Using the handbox

Perform this procedure during the daytime. You will need to have an unobstructed view of an easily sighted landmark, such as a light post. Use a low-power eyepiece, such as the supplied 26mm. This procedure assumes that you have some familiarity with teh handbox‘s menu structure (you will need to locate the „Setup: Telescope“ menu). If necessary, refer to **HANDBOX‘S MENUS**, page 22.

> ***Note:*** *For best result, perform this procedure after you have trained the drive. See page 17.*

1. Adjust the latitude T-handle screws (**10, Fig. 1a**) so that the latitude is set to 45° or higher. See Step #6, page 10, for information about setting the latitude controls.
2. Refer to **Fig. 48** while performing this step. The Dec. motor (**B**) must be positioned so that it is at the back of the mount. The optical tube (**A**) must be approximately horizontal (*i.e.,* parallel with the horizon) and the counterweight shaft must be pointing straight down.

   Loosen the cradle ring locks knobs (**C**) and move the optical tube until the eyepiece (**D**) points downward as shown in the **Fig. 48**. Re-tighten the cradle ring locks.
3. Make sure that both the R.A. and Dec. locks (**1** and **17**, **Fig. 1a**) are tightened to a firm feel.
4. Turn on the handbox and go to „Setup: Telescope.“ Press ENTER.
5. Press one of the Scroll keys until „LXD75 Adjust“ displays and then press ENTER. A message displays that tells you to center a landmark. If the landmark is not visible in your eyepiece, lift and move the entire telescope and tripod assembly—try not to move the tube too far from the horizontal position (no more than 5° up or down), as described in Step #2. You may also use the fine azimuth controls (**11, Fig. 1a**) for side to side movement and the Up/Down Arrows of the handbox for small adjustments to the declination axis.
6. **Caution: Before pressing ENTER, step back from the telescope assembly, as the telescope will begin to rotate about two axes.** When the landmark is centered (Step #5), press ENTER.

The telescope first moves 180° on the Dec. axis and then rotates 180° on the R.A. axis. The handbox displays „Slewing....“.

When the telescope has completed the 180° slew, the telescope will be under the mount instead of over it. The counterweight shaft is now pointed upwards and the cradle adjustment screws (**Fig. 47**) are easily accessible.

7. The handbox again prompts you to center the landmark you have chosen in the eyepiece. Use the Arrow keys to center the object and then press ENTER.
8. The telescope moves again on the R.A. axis. Use the cradle screw adjustment mechanism on the bottom of the cradle to center the landmark in the eyepiece.

   To adjust the cradle screws, use the supplied hex key to loosen the two outside screws. Then adjust the position of the landmark by tightening or loosening the center screw. Perform this adjustment on both sets of screws. When finished, retighten the outer screws. The axis is now aligned.

   **Note:** This procedure maximizes the pointing accuracy of the telescope provided the telescope is always placed on the mount in the same fashion. A mark made on the mount under the saddle will ensure this alignment is maintained.

# Appendix C: Latitude Chart

### Latitude Chart for Major Cities of the World

To aid in the polar alignment procedure (see pages 17-21), 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 (110 km) 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.

**NORTH AMERICA**

| City | State/Prov./Country | Latitude |
|---|---|---|
| Albuquerque | New Mexico | 35° N |
| Anchorage | Alaska | 61° N |
| Atlanta | Georgia | 34° N |
| Boston | Massachusetts | 42° N |
| Calgary | Alberta | 51° 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 |
| Kenosha | Wisconsin | 45° N |
| Las Vegas | Nevada | 36° N |
| Little Rock | Arkansas | 35° N |
| Los Angeles | California | 34° N |
| Mexico City | Mexico | 19° N |
| Miami | Florida | 26° N |
| Minneapolis | Minnesota | 45° N |
| Nashville | Tennessee | 36° N |
| New Orleans | Louisiana | 30° N |
| New York | New York | 41° N |
| Oklahoma City | Oklahoma | 35° N |
| Ottawa | Ontario | 45° N |
| Philadelphia | Pennsylvania | 40° N |
| Phoenix | Arizona | 33° N |
| Portland | Oregon | 46° 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 |

**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 |

**SOUTH AMERICA**

| City | Country | Latitude |
|---|---|---|
| Bogotá | Colombia | 4° N |
| São Paulo | Brazil | 23° S |
| Buenos Aires | Argentina | 35° S |
| Montevideo | Uruguay | 35° S |
| Santiago | Chile | 34° S |
| Caracas | Venezuela | 10° N |

**ASIA**

| City | Country | Latitude |
|---|---|---|
| Beijing | China | 40° N |
| Hong Kong | China | 23° N |
| Seoul | South Korea | 37° N |
| Taipei | Taiwan | 25° N |
| Tokyo | Japan | 36° N |
| Sapporo | Japan | 43° N |
| Bombay | India | 19° N |
| Calcutta | India | 22° N |
| Hanoi | Vietnam | 21° N |
| Jedda | Saudi Arabia | 21° N |

**AFRICA**

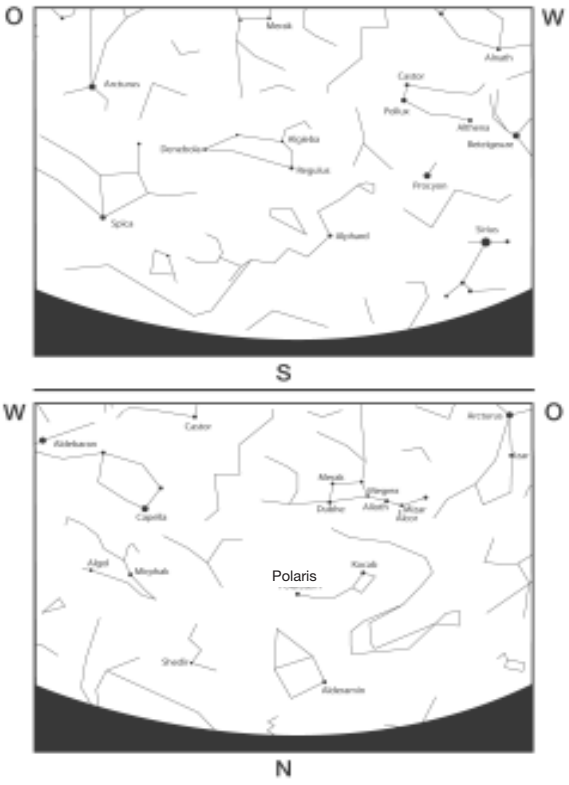
| City | Country | Latitude |
|---|---|---|
| Cairo | Egypt | 30° N |
| Cape Town | South Africa | 34° S |
| Rabat | Morocco | 34° N |
| Tunis | Tunisia | 37° N |
| Windhoek | Namibia | 23° S |

**AUSTRALIA AND OCEANIA**

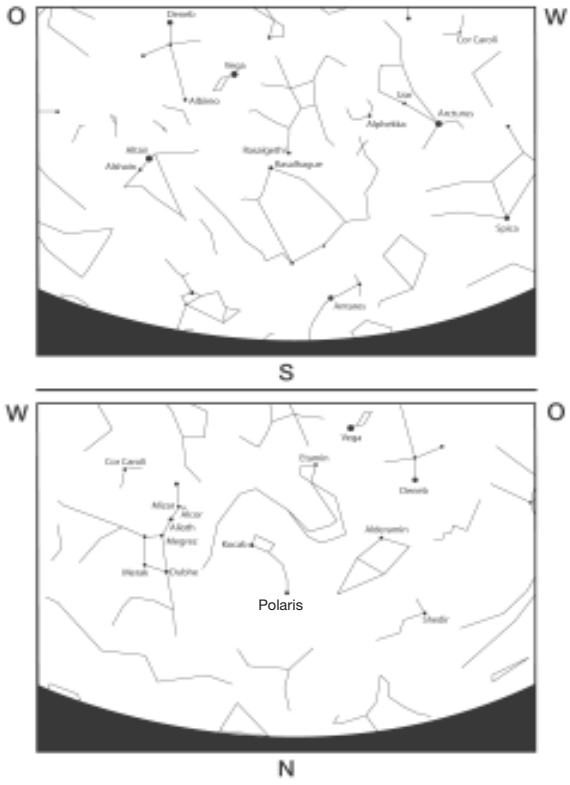
| City | State/Country | Latitude |
|---|---|---|
| Adelaide | South Australia | 35° S |
| Brisbane | Queensland | 27° S |
| Canberra | New South Wales | 35° S |
| Alice Springs | Northern Territory | 24° S |
| Hobart | Tasmania | 43° S |
| Perth | Western Australia | 32° S |
| Sydney | New South Wales | 34° S |
| Melbourne | Victoria | 38° S |
| Auckland | New Zealand | 37° S |

# STAR LOCATOR

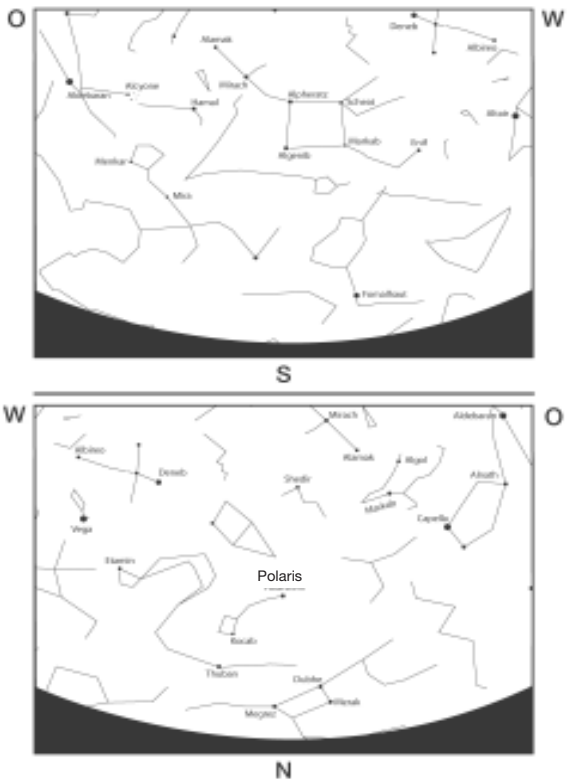
## Spring



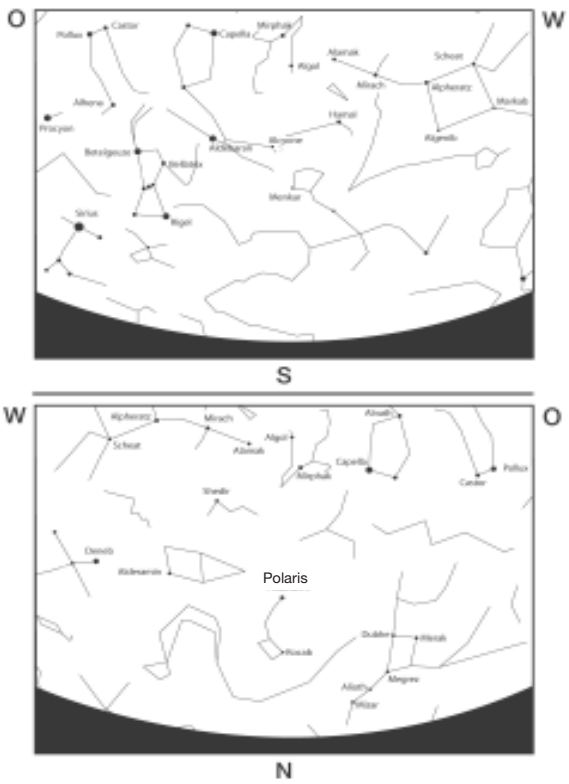

## Summer




## Fall




## Winter



**Meade Instruments Europe**
GmbH & Co. KG

Gutenbergstr. 2 · DE-46414 Rhede
www.meade.de · service.apd@meade.de

ANL4951700GB1211NN