

Instruction Manual

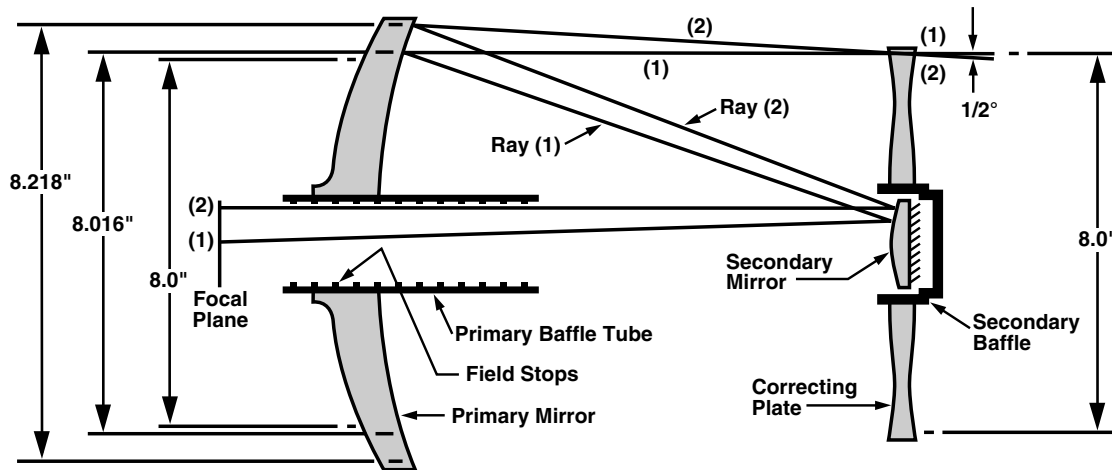
7" LX200 Maksutov-Cassegrain Telescope

8", 10", and 12" LX200 Schmidt-Cassegrain Telescopes



Meade Instruments Corporation

NOTE: Instructions for the use of optional accessories are not included in this manual. For details in this regard, see the Meade General Catalog.

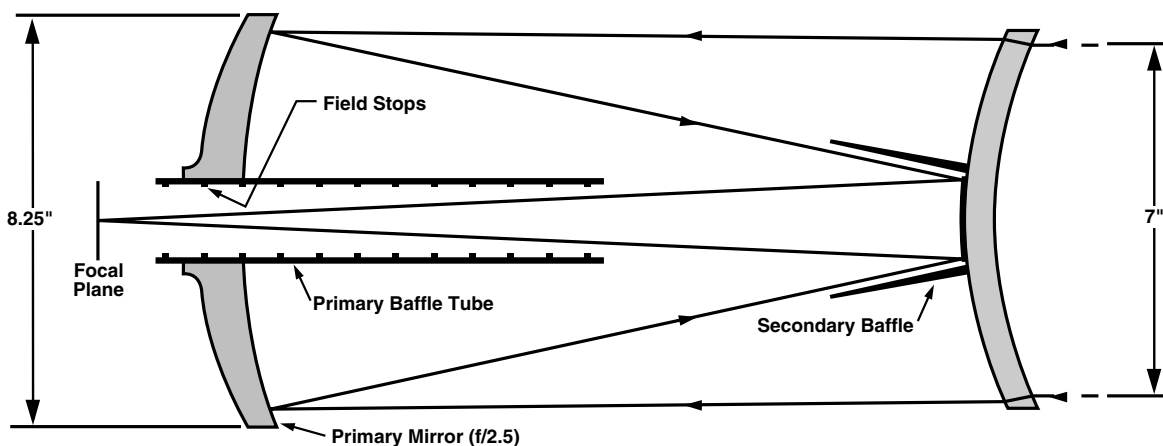


The Meade Schmidt-Cassegrain Optical System (Diagram not to scale)

In the Schmidt-Cassegrain design of the Meade 8", 10", and 12" models, light enters from the right, passes through a thin lens with 2-sided aspheric correction ("correcting plate"), proceeds to a spherical primary mirror, and then to a convex aspheric secondary mirror. The convex secondary mirror multiplies the effective focal length of the primary mirror and results in a focus at the focal plane, with light passing through a central perforation in the primary mirror.

The 8", 10", and 12" models include oversize 8.25", 10.375" and 12.375" primary mirrors, respectively, yielding fully illuminated fields-of-view significantly wider than is possible with standard-size primary mirrors. Note that light ray (2) in the figure would be lost entirely, except for the oversize primary. It is this phenomenon which results in Meade 8", 10", and 12" Schmidt-Cassegrains having off-axis field illuminations 10% greater, aperture-for-aperture, than other Schmidt-Cassegrains utilizing standard-size primary mirrors. The optical design of the 4" Model 2045D is almost identical but does not include an oversize primary, since the effect in this case is small.

LX200 Schmidt-Cassegrain telescopes now feature new baffle tube designs. These computer-optimized designs incorporate a series of 7 to 11 (depending on the focal ratio and size of the LX200) internal field-stops to eliminate almost all internal reflections, yielding the best image contrast available in any Schmidt-Cassegrain available today.



The Meade 7" Maksutov-Cassegrain Optical System (Diagram not to scale)

The Meade 7" Maksutov-Cassegrain design optimizes imaging performance by utilizing a combination of two-sided spherical meniscus lens (*right*), a strongly *aspheric* f/2.5 primary mirror, and a spherical secondary mirror. The convex secondary mirror multiplies the effective focal length of the primary by a factor of six, resulting in an overall f/15 system at the Cassegrain focus.

The oversize 8.25" primary mirror results in a fully-illuminated (unvignetted) field of view significantly wider than can be obtained with Maksutov optics incorporating primary mirrors of the same aperture as their meniscus correcting lenses. Computer-optimized primary and secondary mirror baffles, as well as a sequence of field stops internal to the primary mirror baffle, yield lunar, planetary, stellar, and deep-space images of uncommonly high contrast and resolution.

✴ **WARNING!** ✴

Never use the LX200 telescope to look at the Sun! Looking at or near the Sun will cause *instant* and *irreversible* damage to your eye. Eye damage is often painless, so there is no warning to the observer that damage has occurred until it is too late. Do not point the telescope or its viewfinder at or near the Sun. Do not look through the telescope or its viewfinder as it is moving. Children should always have adult supervision while observing.

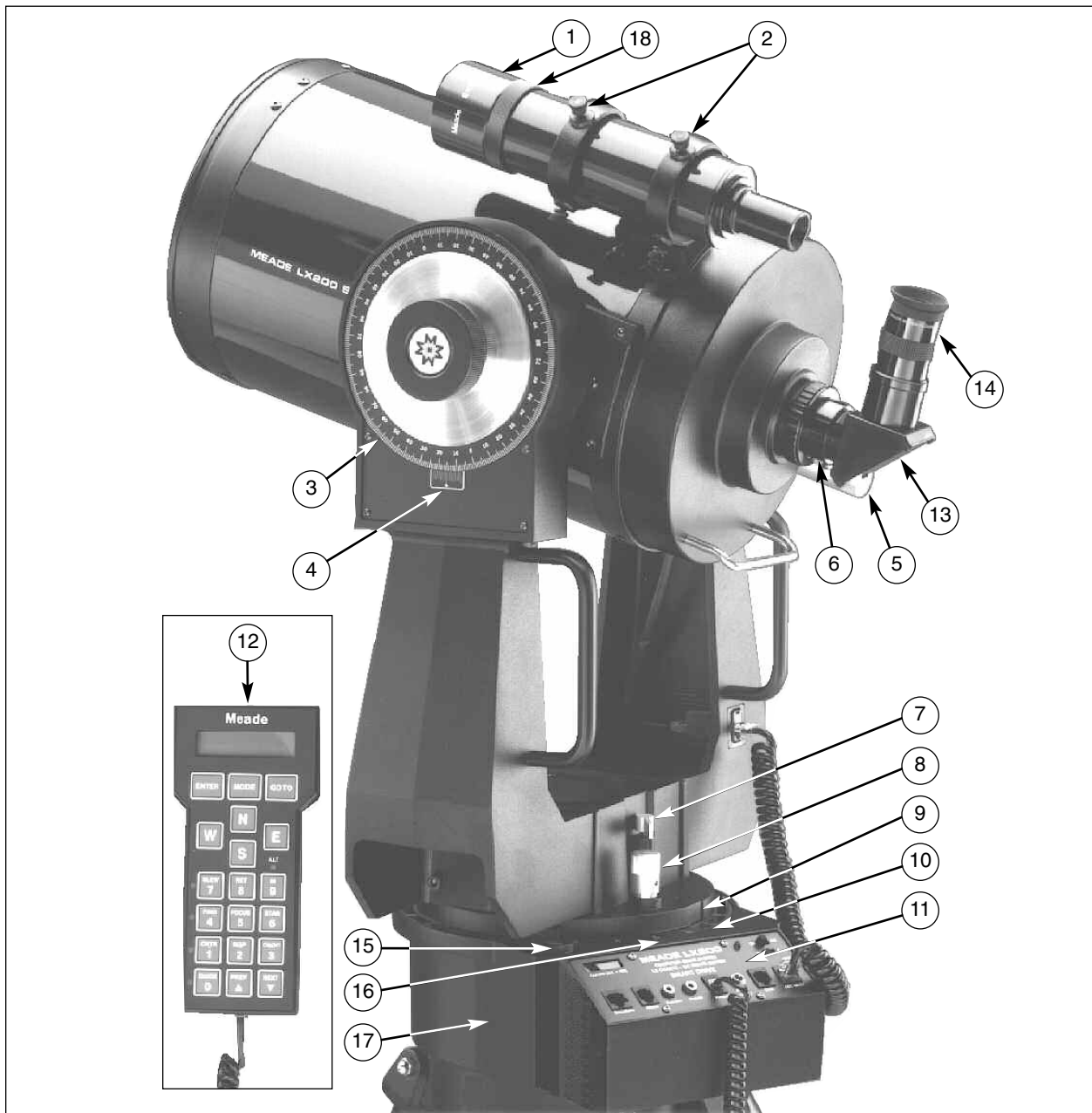


Fig. 1: 8" LX200 Telescope.

Captions for Figure 1

- | | |
|---|------------------------------------|
| 1. Viewfinder Dew Shield | 10. Right Ascension Setting Circle |
| 2. Viewfinder Collimation Screws | 11. Power Panel |
| 3. Declination (Dec) Setting Circle | 12. Keypad Hand Controller |
| 4. Declination Pointer | 13. Diagonal Mirror |
| 5. Focus Knob | 14. Eyepiece |
| 6. Eyepiece Holder | 15. Bubble Level |
| 7. Right Ascension (R.A) Lock | 16. Hour Angel (HA) Pointer |
| 8. Right Ascension Slow-Motion Controls | 17. Drive Base |
| 9. Right Ascension Vernier Pointer | 18. Viewfinder Focus Lock Ring |

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INTRODUCTION

As a new LX200 owner, you are preparing for a journey into the universe with the most advanced amateur telescope ever produced. The advent of this instrument is the culmination of twenty years of innovation and design at Meade Instruments; never before have the features you have in your hands been available to amateur astronomers: from robotic object location to the revolutionary Smart Drive and the most stable mounting structure ever. Your telescope comes to you ready for adventure; it will be your tour guide and traveling companion in a universe of planets, galaxies, and stars.

Meade 8", 10", and 12" LX200 Schmidt-Cassegrain and 7" Maksutov-Cassegrain telescopes are instruments of advanced mirror-lens design for astronomical and terrestrial applications. Optically and mechanically, the 7", 8", 10", and 12" telescope models are perhaps the most sophisticated and precisely manufactured telescopes ever made available to the serious amateur. These telescopes enable the visual astronomer to reach out for detailed observations of the Solar System (the planets: Jupiter, Saturn, Mars) and beyond to distant nebulae, star clusters, and galaxies. The astrophotographer will find a virtually limitless range of possibilities since, with the precision Meade worm-gear motor drive system, long exposure guided photography becomes not a distant goal, but an achievable reality. The capabilities of the instrument are essentially limited not by the telescope, but by the acquired skills of the observer and photographer.

The 7", 8", 10", and 12" LX200 are, with the exception of a few assembly operations and features, almost identical operationally. Most standard and optional accessories are interchangeable between the three telescopes. The instructions in this manual generally apply to all three telescopes; when exceptions to this rule occur, they are clearly pointed out.

Important Note: *If you are anxious to use your Meade LX200 Telescope for the first time, at the very least be sure to read **TELESCOPE ASSEMBLY** (page 7), and **QUICK START** (page 9) sections of this manual. Thereafter, we urge you to read the balance of this manual thoroughly at your leisure, in order that you may fully enjoy the many features offered by the instrument.*

1. What Is the LX200? An Overview

Meade LX200 SCT's mark a new era in telescope technology for the amateur astronomer, whether beginner or seasoned veteran. For the beginner LX200 electronics permit the location and observation of the major planets as well as hundreds of deep-sky objects the very first night you use the telescope. For the experienced amateur the telescopes' pushbutton electric slewing, digital readouts, Smart Drive, and much more open up visual and photographic capabilities heretofore undreamed of.

a. Heavy-Duty Mounts with 9-speed Dual-Axis Electronics

DC-servo-motor-controlled worm gear drives on both telescope axes permit observatory-level precision in tracking, guiding, and slewing. The 9-speed dual-axis drives cover every possible contingency of telescope positioning: Press the SLEW button on the keypad controller for rapid motion of the telescope across the skies at up to 8 degrees per sec. (6 degrees per sec. for the 12" LX200) on both axes simultaneously; once near the target, switch instantly to the FIND speed for centering in the viewfinder at 2 degrees per sec. Observing the object in the main telescope, use the CNTR speed (32x sidereal) to place the object in the center of the field. During long-exposure astrophotography press the GUIDE button for precise corrections at 2x sidereal speed.

b. Built-in 64,359-Object Library

Enter into the keypad any of the 110 Messier objects, 7,840 of the finest NGC objects (galaxies, diffuse or planetary nebulae, star clusters), one of the 8 major planets from Mercury to Pluto,

one of 351 alignment stars or any one of 56,050 SAO, UGC, IC or GCVS objects, press GO TO, and the telescope automatically slews, or moves, to the object at up to 8° per sec., centering it in the main telescope field.

c. Altazimuth Mode Operation

For all visual observing applications, and for lunar and planetary photography, Meade LX200's may be set up in the Altazimuth mode. Just attach the telescope's drive base directly to the tripod, use the fast 1-star alignment procedure, and the telescope's computer actuates 2-axis tracking that keeps objects precisely centered in the field, even at high powers, during the entire observing session.

d. Terrestrial Operation

Meade LX200's make incredible land-view telescopes. Set the telescope up in the Altazimuth format, activate the Land menu option on the telescope's computer, and use the keypad to track land objects on both axes at any of the same 4 drive speeds!

e. Keypad and Power Panel Functions

The multifunction capability of LX200's includes direct connection of popular CCD autoguider/imagers; RS-232 serial interface with a personal computer (PC), allowing the user to perform all of the keypad functions through, or write custom telescope software for a PC; brightness level control of an illuminated reticle eyepiece from the keypad and including special pulse-mode reticle operation.

2. Standard Equipment

a. 7" Model LX200

Includes 7" Maksutov-Cassegrain optical tube assembly with EMC super multi-coatings (D = 178mm, F = 2670mm-f/15); heavy-duty fork mount, with 4"-dia. sealed polar ball bearing, quartz-microprocessor-controlled 5.75" worm gears on both axes; setting circles in RA and Dec; handheld keypad Electronic Command Center with digital readout display, permanently-programmable Smart Drive, 9-speed drive control on both axes, GO TO controller, High-Precision Pointing, and 64,340-object onboard celestial software library; internal tube-cooling fan for rapid image stabilization; 25 ft. power cord and adapter for telescope operation from 115v.AC; 8 x 50mm viewfinder; eyepiece-holder and diagonal prism (1.25"); Series 4000 SP26mm eyepiece; variable-height field tripod; operating instructions.

b. 8" Model LX200

Includes 8" Schmidt-Cassegrain optical tube assembly with EMC super multi-coatings (D = 203mm, F = 1280mm-f/6.3 or 2000mm-f/10); heavy-duty fork mount, with 4"-dia. sealed polar ball bearing, quartz-microprocessor-controlled 5.75" worm gears on both axes, and multi-function power panel display on the drive base; manual and electric slow-motion controls on both axes; setting circles in RA and Dec; handheld keypad Electronic Command Center with digital readout display, PPEC Smart Drive, 9-speed drive control on both axes, GO TO controller, High-Precision Pointing, and 64,340-object onboard celestial software library; 25 ft. power cord and adapter for telescope operation from 115v.AC; 8 x 50mm viewfinder; eyepiece-holder and diagonal prism (1.25"); Series 4000 SP26mm eyepiece; variable-height field tripod; operating instructions.

c. 10" Model LX200

Includes 10" Schmidt-Cassegrain optical tube assembly with EMC super multi-coatings (D = 254mm, F = 1600mm-f/6.3 or 2500mm-f/10); heavy-duty fork mount, with 4"-dia. sealed polar ball bearing, quartz-microprocessor-controlled 5.75" worm gears on both axes, and multi-function power panel display on the drive base; manual and electric slow-motion controls on both axes; setting circles in RA and Dec; handheld keypad Electronic Command Center with digital readout display, PPEC Smart Drive, 9-speed drive control on both axes, GO TO controller, High-Precision Pointing, and 64,340-object onboard

celestial software library; 25 ft. power cord and adapter for telescope operation from 115v.AC; 8 x 50mm viewfinder; eyepiece-holder and diagonal prism (1.25"); Series 4000 SP26mm eyepiece; variable-height field tripod; operating instructions.

d. 12" Model LX200

Includes 12" Schmidt-Cassegrain optical tube assembly with EMC super multi-coatings (D = 305mm, F = 3048mm-f/10); heavy-duty fork mount, with 4"-dia. sealed polar ball bearing, quartz-microprocessor-controlled 5.75" worm gears on both axes, and multi-function power panel display on the drive base; manual and electric slow-motion controls on both axes; setting circles in RA and Dec; handheld keypad Electronic Command Center with digital readout display, PPEC Smart Drive, 7-speed drive control on both axes, GO TO controller, High-Precision Pointing, and 64,340-object onboard celestial software library; 25 ft. power cord and adapter for telescope operation from 115v.AC; 8 x 50mm viewfinder; 2" diagonal mirror with 1.25" adapter; Series 4000 SP26mm eyepiece; giant field tripod; foam-fitted carrying case; operating instructions.

UNPACKING AND INSPECTION

As you begin to unpack your telescope from its cartons, you will probably be interested in setting it up right away; we certainly understand your excitement but please take a few minutes to read this page before doing so. You should verify that you have all the proper equipment, and that it has arrived to you undamaged.

We strongly recommend that you keep your original packing materials. If it should ever become necessary for you to return your telescope to the Meade factory for servicing, these will help ensure that no shipping damage will occur.

Meade LX200 telescopes supplied to countries outside the U.S.A. are identical to those offered domestically, with the exception of the AC wall adapter.

1. What You Should Have

Carefully unpack and remove all the telescope parts from their packing material. Compare each part to the Standard Equipment. You may wish to place a check next to each item as you identify it. These Packing Programs represent the original specifications for this instrument. Each telescope has been inspected twice at the factory to confirm the inclusion of every item.

2. Please Look Everything Over

Meade Instruments and your shipper have taken precautions to ensure that no shipping damage will occur, but if your shipment has suffered severe vibration or impact damage (whether or not the shipping cartons show damage) then it is important that you retain all the original packing and contact the shipper to arrange a formal inspection of the package or packages. This procedure is required prior to any warranty servicing by Meade Instruments.

3. Inspecting the Optics

Note on the "Flashlight" Test: If a flashlight or other high-intensity light source is pointed down the main telescope tube, you may at first be shocked at the appearance of the optics. To the uninitiated, the view (depending on your line of sight and the angle the light is coming from) may reveal what would appear to be scratches, dark or bright spots, or just generally uneven coatings, giving the appearance of poor surface quality. These effects are only seen when a high intensity light is transmitted through lenses or reflected off the mirrors, and can be seen on any high quality optical system, including the giant research telescopes in use today. It should be pointed out, however, that optical quality cannot be judged by this grossly misleading "test", but through careful star testing. The Flashlight Test causes even the very best optics to look "terrible".

As the high intensity light passes through the Schmidt corrector plate, most of it is transmitted through (about 98%+) while the rest of the light scatters through the glass. As the light hits the mirrored surfaces, most of it is reflected back (about 94%) while the rest of it scatters across the coatings. The total amount of scattered light will be significant, and its effects allow you to see microscopic details that are normally invisible to the unaided eye. These anomalous details are real, but their combined effects will in no way impose limits on the optical performance, even under the most demanding observing or imaging criteria.

4. Caution: All LX200 Owners

CAUTION: Serious damage to the drive gears may result from shock in handling, while transporting or commercially shipping the LX200, should the R.A. lock (7, Fig. 1), and/or the Dec. lock (2, Fig. 4) be left engaged. Always release the locks when storing in the case, or when crating for commercial shipment to allow the telescope to give, if the case or crate is sharply jarred or dropped.

Also, the optical and mechanical axes of all LX200 telescopes have been carefully aligned at the factory to ensure accurate object pointing. Do not loosen or remove the fork arms or optical tube assembly from the drive base; the resulting misalignment of the axes will result in inaccurate slewing of the telescope in the GO TO mode.

5. Caution: 10" and 12" LX200 Owners

CAUTION: Do not attempt to turn the focuser knob of the optical tube until you have read this note!

NOTE: Next to the base of the focuser you will see a red-colored slotted head bolt. This bolt is used only for safety in shipment. Remove this bolt before attempting to turn the focuser knob. In its place, insert the rubber plug provided as a dust protector (this rubber plug is included with your hardware package).

Your focuser is now operational.

WARNING: The 10" and 12" LX200 should never be commercially shipped without this red-colored bolt in place. This is essential during commercial transport where rough handling may occur. For your personal transport and storage, you will never have to use this bolt again.

a. Commercial Reshipment

To commercially re-ship the telescope, be sure to follow this procedure:

1. Turn the focuser knob clockwise until it stops. This will bring the primary mirror all the way back in the tube.
2. Remove the rubber plug and insert the red-headed bolt. Thread it in to a firm snug feel. Do not overtighten. (If you have misplaced the red-headed bolt, you may use any other bolt that is 1/4-20x1" long.
3. When packaging the 10" or 12" LX200, be sure to release the R.A. lock (7, Fig. 1), and Dec. lock (2, Fig. 4), to prevent shock to the gears in the motor assemblies should the package suffer severe handling.

Please note that commercial shipment of the 10" and 12" LX200 Telescope without the safety bolt in place and packed in the original factory supplied shipping containers as described above is done at the owner's risk and your warranty may be voided if shipping damage results.

6. Keypad Version Number

The current keypad version is 3.20 (see sticker on back of keypad). This does not indicate the telescope software version—which is displayed on the keypad LED at power-up.

TELESCOPE ASSEMBLY

Use the following steps to assemble your telescope.

NOTE: If the section is not applicable to all LX200 models, it is noted at the beginning of each section.

1. The Field Tripod

The field tripods (Figs. 2 and 3) for Meade 8", 10", and 12" LX200 telescopes are supplied as completely assembled units, except for the spreader bar (4, Fig. 2) and the 6 lock knobs (2 knobs for each of the 3 tripod legs) used to adjust the height of the tripod. These knobs are packed separately for safety in shipment.

For visual (*i.e.*, non-photographic) observations, the drive base (17, Fig. 1) of the telescope's fork mount is attached directly to the field tripod. The telescope in this way is mounted in an "Altazimuth" ("Altitude-Azimuth," or "vertical-horizontal") format. The telescope in this configuration moves along vertical and horizontal axes, corresponding respectively to the Declination and Right Ascension axes (explained later in this manual) in an astronomical observing mode.

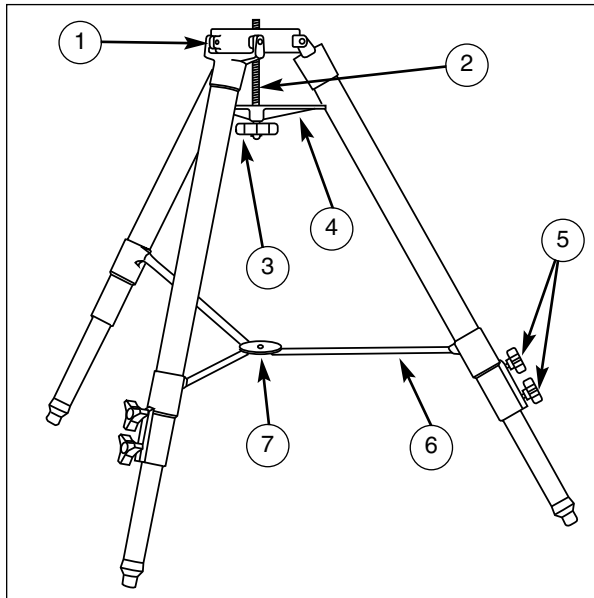


Fig. 2: LX200 Field Tripod. (1) Tripod Head; (2) Threaded Rod; (3) Tension Knob; (4) Spreader Bar; (5) Lock Knobs; (6) Extension Strut; (7) Tension Hub.

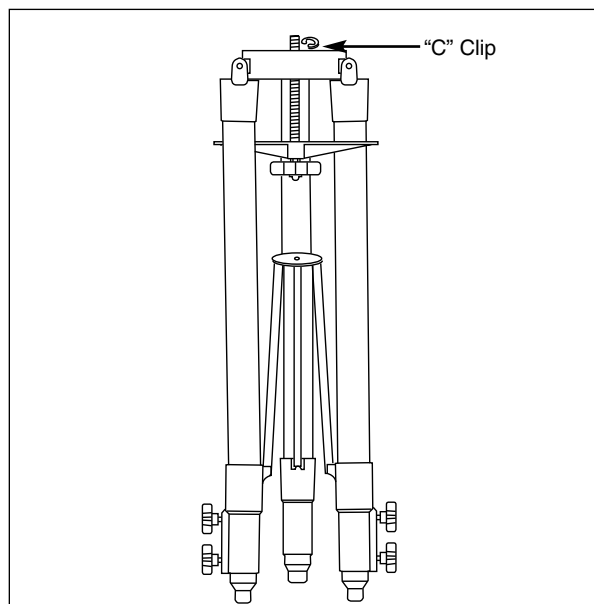


Fig. 3: Field Tripod (collapsed).

Alternately, the field tripod can be used in conjunction with the appropriate optional equatorial wedge (**APPENDIX A**, page 25) for long exposure astrophotography. The equatorial wedge permits alignment of the telescope's Polar Axis with the Celestial Pole (or North Star).

After removing the field tripod from its shipping carton, stand the tripod vertically, with the tripod feet down and with the tripod still fully collapsed (see Fig. 3). Grasp two of the tripod legs and, with the full weight of the tripod on the third leg, gently pull the legs apart to a fully open position.

Thread in the 6 lock-knobs (2 on each tripod leg) near the foot of each tripod leg (Fig. 2). These lock-knobs are used to fix the height of the inner, extendible tripod leg sections.

NOTE: "Firm feel" tightening is sufficient; over-tightening may result in stripping of the knob threads or damage to the tripod legs and results in no additional strength.

The spreader bar (4, Fig. 2) has been removed for shipment. To replace, first remove the threaded rod (2, Fig. 2) from the tripod head (1, Fig. 2); a small piece of plastic holds the threaded rod in place. Remove the small plastic bag that is stapled to the threaded rod. This bag contains the "C" clip clip retainer (used below) and an extra clip.

Slide the spreader bar onto the threaded rod (note the correct orientation as shown in Fig. 2) and position the threaded rod back through the tripod head. Place the clip retainer (a "C" clip) into the slot in the threaded rod. This clip holds the threaded rod in place. See Fig. 3.

Position the spreader bar so that the 3 arms of the spreader bar are lined up with the 3 tripod legs.

Place the entire telescope onto the top of the tripod head, and thread the threaded rod into the central threaded hole in the bottom of the drive base of the telescope. Tighten the tension knob (3, Fig. 2); firm tightening of the tension knob is sufficient to result in rigid positioning of the tripod legs.

To vary the tripod height, loosen the 6 lock-knobs, slide the 3 inner tripod leg sections out to the desired height, and firmly re-tighten (but do not overtighten) the 6 lock-knobs.

To collapse the tripod (after removing the telescope and equatorial wedge, if applicable) for storage follow these steps:

- Rotate the spreader bar 60° from its assembled position, so that one spreader bar arm is located between each adjacent pair of tripod legs.
- At the base of the tripod is a 3-vane extension strut system, with a circular hub at its center (7, Fig. 2). Grasp the tripod head (1, Fig. 2) with one hand and, with the other hand, pull directly "up" on the central hub of the extension strut system. This operation will cause the tripod legs to move inward to a collapsed position.

PRECAUTIONARY NOTES

- If the tripod does not seem to extend or collapse easily, do not force the tripod legs in or out. By following the instructions above, the tripod will function properly, but if you are unclear on the proper procedure, forcing the tripod into an incorrect position may damage the extension strut system.
- Do not overtighten the 6 lock-knobs used to fix the inner tripod leg sections at various heights. "Firm feel" tightening is sufficient.
- Be sure the spreader bar (4, Fig. 2) is not upside-down on the threaded rod.

2. Mounting the Viewfinder

Each 7", 8", 10", and 12" LX200 telescope is supplied as standard equipment with an 8x50mm straight-through viewfinder. The bracket for this viewfinder is packed separately from the finder itself, and 6 black nylon thumbscrews for collimation are pre-threaded into the viewfinder bracket. The viewfinder bracket mounts onto the telescope with a quick-release mount. See Fig. 1.

a. Attaching the Viewfinder

The viewfinder is shipped separately from the bracket and must be installed into the bracket. Slide the viewfinder into the bracket and lightly tighten the 6 collimation (alignment) screws (2, Fig. 1).

The quick-release mount allows the viewfinder to be easily attached or removed from the telescope. To attach the unit, simply slide the viewfinder with bracket into the mating base on the telescope and tighten the two thumbscrews.

b. Focusing the Viewfinder

The viewfinder has been pre-focused at the factory. However, should it become necessary to adjust the focus, follow these steps:

1. Loosen the focus lock ring (18, Fig. 1).
2. While looking at a star, rotate the Dew Shield (1, Fig. 1) until the star is in focus. (This refocuses the objective lens.)

CAUTION: Take care when rotating counter clockwise. You are unthreading the dew shield and it may fall off if rotated too far. Refocusing the objective lens will only require a few turns of the Dew Shield at most.

3. When the Dew Shield is rotated to the sharpest focus for your eye, tighten the focus lock ring against the Dew Shield to fix its position.

c. Collimating the Viewfinder

The viewfinder will require alignment, or collimation, with the main telescope. Using the 26mm eyepiece, point the main telescope at some easy to find land object (e.g., the top of a telephone pole or corner of a building) at least 200 yards distant. Center a well-defined object in the main telescope. Then, simply turn the 6 nylon collimation thumbscrews (2, Fig. 1) until the crosshairs of the viewfinder are precisely centered on the object already centered in the main telescope. With this collimation accomplished, objects located first in the wide-field viewfinder will then be centered in the main telescope's field of view.

3. Attaching the Diagonal Mirror and Eyepiece

The eyepiece holder (6, Fig. 1) threads directly onto the rear-cell thread of the 8" and 10" telescopes. The diagonal prism (13, Fig. 1) slides into the eyepiece holder of the 7", 8" and 10" telescopes, while the 2" diagonal mirror threads directly into the rear-cell thread of the 12" telescope. In turn, both the diagonal prism and diagonal mirror accept the supplied 1-1/4" O.D. eyepiece.

For astronomical observations, the diagonal prism or mirror generally provides a more comfortable right-angle viewing position. Alternately, in the 8" and 10" telescopes, an eyepiece may be inserted directly into the eyepiece holder for straight-through observations, the 12" telescope requires the accessory eyepiece holder. Note in this case, however, that the image will appear inverted and reversed left-for-right. With the diagonal prism and mirror, telescopic images appear correctly oriented up-and-down, but still reversed left-for-right. For terrestrial applications, where a fully corrected image orientation is desired, both up-and-down and left-for-right, the optional #924 Erecting Prism* or #928 45° Erect-Image Diagonal Prism should be ordered separately. Eyepieces and the diagonal prism are held in their respective places on the telescope by a moderate tightening of the thumbscrews on the diagonal prism and eyepiece holder.

4. Checking the Collimation of the Optics

The optical systems of all Meade Schmidt-Cassegrains are precisely collimated, or aligned, before leaving the factory. However, if the telescope has received a severe jolt in shipment the optics can become de-collimated, a situation which may result in serious image degradation. Recollimating the optics is, however, a simple procedure which is easily performed by the telescope user. We urge all LX200 owners to confirm the collimation of their telescope, and to recollimate the optics if necessary. For details in this regard, see page 82.

NOTE: There is no collimation procedure required for the Meade 7" Maksutov-Cassegrain telescope. Factory alignment assures optimal viewing accuracies.

5. 12" Tube Swing-Through Limit

The length of the 12" LX200 optical tube prohibits the correcting plate end of the tube from swinging through the fork arms — the tube will hit the mount. When the telescope is aligned, the software will stop the telescope from moving into the mount. If the telescope is not aligned, there are also mechanical stops.

When in LAND or ALTAZ modes, this limit does not restrict any sections of the sky, since the limit is set at 45° from straight down. When in the POLAR mode, some parts of the sky might be restricted, depending on the latitude of the observing site.

Observing sites with latitudes higher than 45° will not have any restrictions. Latitudes below 45° will have the southern horizon restricted somewhat. To determine the amount of sky not available, subtract the latitude of the observing site from 45. This will give the number of degrees of southern horizon that the 12" LX200 will not move to. For example, if the latitude of the observing site is 35°, then 10° (45-35) of southern sky is unavailable for observations.

6. 7" Tube Swing-Through Limit

The length of the 7" LX200 optical tube prohibits the correcting plate end of the tube from swinging through the fork arms — the tube will hit the mount. When the telescope is aligned, the software will stop the telescope from moving into the mount. If the telescope is not aligned, there are also mechanical stops and some parts of the sky might be restricted if using a wedge, depending on the latitude of the observing site.

Observing sites with latitudes higher than 45° will not have any restrictions. Latitudes below 45° will have the southern horizon somewhat restricted when using a wedge and polar aligning. To determine the amount of sky not available, subtract the latitude of the observing site from 45, this will give the number of degrees of the southern horizon that the 7" LX50 will not reach. For example, if the latitude of the observing site is 35°, then 10° (45 – 35) of southern sky is unavailable for observations. No restrictions of observable sky occur in the altaz mode of alignment and operation.

7. Maksutov Fan

The Maksutov optics are equipped with a fan which will assist in the stabilization of the temperature of these optics. The fan will operate when a special power cord (supplied in the accessory box) is plugged into the fan and the LX50 panel plug marked "Aux" with the power switch in the "ON" position. The amount of time required to stabilize the temperature will be dependent upon ambient conditions including the observation site and preexisting condition of the telescope. The fan should be activated at the beginning of the observation session to accelerate the temperature stabilization. As soon as the optics have reached an equilibrium with the environment the fan should be turned off by unplugging the fan power cord. Fan operation time should range between 5 and 25 minutes. While it is permissible to run the fan continuously it is not recommended because the very slight vibration of the fan may cause noticeable movement of the objects observed in the sensitive optics.

QUICK START

To utilize all the features of the telescope, it is necessary to enter some information into the telescope's computer memory, and learn the menu structure of the keypad hand controller, which is described in the rest of this manual. As advanced as LX200 electronics are, the telescope is very straightforward to operate — even if you have no experience whatsoever in using a personal computer.

If you are reading this manual for the first time and are anxious to “look through the telescope”, this section will describe how to use the telescope without going through the rest of the manual. But be sure to come back and read the details, for most of the telescope's features can not be accessed without a full knowledge of these details.

1. Using the LX200 Manually

The easiest way to use the telescope is to simply operate it manually. With the telescope mounted on the field tripod (see **The Field Tripod**, page 7), and with the diagonal prism and eyepiece in place, you are ready to make observations through the telescope. Even without the viewfinder (if not yet installed), terrestrial objects will be fairly easy to locate and center in the telescope's field of view with a low power eyepiece, simply by “gun sighting” along the side of the main telescope tube.

By unlocking the R.A. lock (7, Fig. 1), the telescope may be turned rapidly through wide angles in Right Ascension (R.A.). The reason for the terminology Right Ascension and its complementary term, Declination will be made clear later in this manual. For now, Right Ascension simply means “horizontal” and Declination means “vertical”. Fine adjustments in R.A. are made by turning the R.A. slow-motion control knob (8, Fig. 1), while the R.A. lock is in the “unlocked” position.

CAUTION: Do not attempt to move the telescope manually in a horizontal direction when the R.A. lock is in the “locked” position.

The R.A. slow-motion control knob may be turned, if desired, with the R.A. lock in a “partially locked” position. In this way, a comfortable “drag” in R.A. is created. But do not attempt to operate the R.A. slow-motion control knob with the telescope fully locked in R.A., as such operation may result in damage to the internal gear system.

Releasing the Declination lock knob (2, Fig. 4), permits sweeping the telescope rapidly through wide angles in Declination.

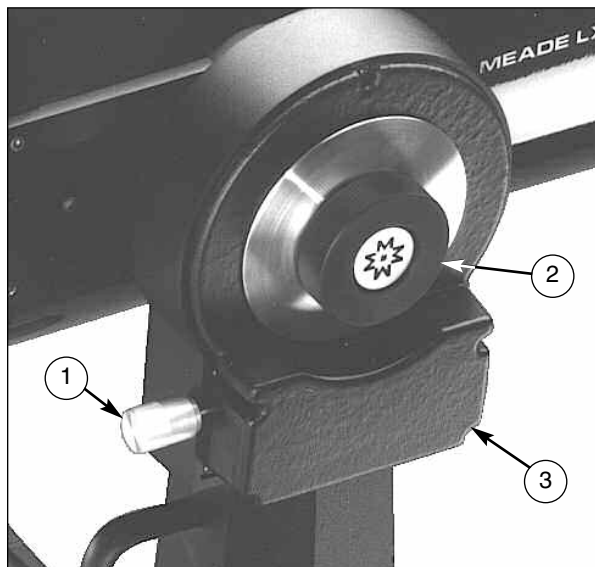


Fig. 4: LX200 Declination (Vertical) System. (1) Manual Slow-Motion Control Knob; (2) Declination Lock Knob; (3) Declination Worm Gear Cover.

To use the Declination fine-adjust, or manual slow-motion knob, lock the telescope in Declination using the Declination lock knob (2, Fig. 4), and turn the Declination slow-motion knob (1, Fig. 4).

With the above mechanical operations in mind, select an easy to find terrestrial object as your first telescope subject — for example, a house or building perhaps one-half mile distant.

Unlock the Declination lock knob (2, Fig. 4), and R.A. lock (7, Fig. 1), center the object in the telescopic field of view and then re-lock the Dec. and R.A. locks. Precise image centering is accomplished by using the Dec. and R.A. slow-motion controls.

The focus knob (5, Fig. 1) is located at the “4 o'clock” position as you face the rear cell of the telescope. Focusing is accomplished internally by a precise motion of the telescope primary mirror so that, as you turn the focus knob, there are no externally moving parts. You will find that if you turn the focus knob counter-clockwise you are focusing towards the infinity setting, and turning clockwise is for close distance. There are about 45 complete turns to go from one end of focus to the other, and it is possible to focus past infinity. Be patient during focusing as images quickly go in and out of focus with only a slight amount of turning of the focus knob.

2. Using the LX200 In LAND

The 7", 8", 10", and 12" LX200 telescopes are shipped with the microprocessor set to LAND, the align menu option you will wish to use to view terrestrial objects. In this menu option 4 different motion speeds are active, allowing the telescope to be moved electronically by means of the keypad. To use the telescope in Land, follow these steps.

- a. Loosen the Dec. lock knob (2, Fig. 4) and position the optical tube approximately level, so that the Dec. setting circle (3, Fig. 1) reads 0°. Retighten the Dec. lock knob.
- b. Loosen the R.A. lock (7, Fig. 1) and rotate the telescope so that the R.A. pointer (9, Fig. 1) and the HA pointer (16, Fig. 1) are approximately in line with each other. This will position the fork arms so that they are parallel to the power panel (11, Fig. 1). Tighten the R.A. lock

The above two steps are not necessary for the telescope to work, so don't worry about having to get it exactly right. The telescope has some “illegal” positions, places where the telescope will not go and these two steps insure proper operation.

- c. After setting up the telescope, plug in both coil cords with the keypad, one of the supplied power sources, either the AC Wall Adapter Power Converter (for AC current wall outlets), or the optional DC Cigarette Lighter Power Cord (used in an automobiles cigarette lighter outlet, with the ignition turned on only to allow the electric power on from the car battery).
- d. Turn on the power switch on the power panel of the LX200. The keypad display (1, Fig. 5) will show “MEADE” for several seconds as the microprocessor does a self-diagnostic test. When the self-diagnostic test is complete, the display will show “TELESCOPE” on the top line, “OBJECT LIBRARY” on the lower line, and the red LED light next to the “SLEW” button will light up.
- e. At this point, the LX200 is ready to use. Select the speed at which you want to move the telescope by pressing the appropriate Speed Selection Key (4, Fig 5). Note that you will be able to “see” the telescope move only in the SLEW and FIND modes; CNTR (center) and GUIDE motions can only be seen while looking through the telescope. The red LED next to that key (3, Fig. 5) will light, indicating the speed selected. Then press one of the four direction keys (2, Fig. 5) to move the telescope in that direction at the selected speed.

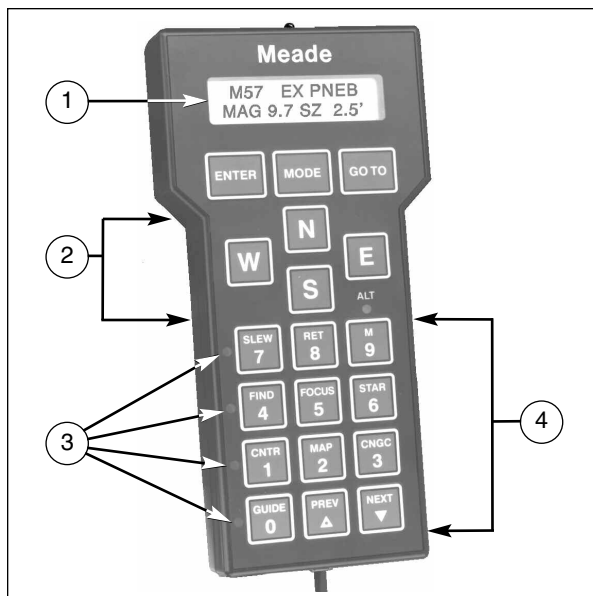


Fig. 5: Keypad Hand Controller. (1) Display; (2) Direction Keys; (3) Speed Indicator LEDs; (4) Speed Selection Keys.

Motion Speeds

SLEW	(7) = 8°/sec (8", 10"); 6°/sec (12")
FIND	(4) = 2°/sec
CNTR	(1) = 480 arcsec/sec
GUIDE	(0) = 30 arcsec/sec

The LX200 can also be moved manually with the R.A. and Dec. locks released, or as described above only. The Declination manual slow-motion knob (1, Fig.4) is non-functional when power is supplied to the telescope. When the power is "on", only use the N, S, E, and W keys on the keypad hand controller. Serious damage can occur to the internal gears of the motor assembly if the Declination manual slow-motion knob is turned even a slight amount by hand.

3. Using the LX200 In ALTAZ (Altazimuth)

The two quick start methods described above allow you to use the telescope, but do not make use of any of the computer features available, including finding objects from the Object Library and automatic tracking of stars. In order for these features to work, the telescope's power needs to be "on," and the computer needs some basic information, which is entered through the keypad. Once entered, the information is permanently remembered by the telescope's computer and need never be entered again, even if the telescope is turned "on" and "off" many times.

This section will explain what keys to push to get the minimum data required into the computer, without any detailed explanation (see **MODE FUNCTIONS**, page 16, for detailed instructions). The steps detailed here only take a few minutes and allow you to begin making use of all the LX200 features.

a. Entering Basic Information

In order for the LX200 to make the conversions between the stellar coordinate system (R.A. and Declination) and the Altazimuth coordinate system (altitude and azimuth), it needs to know three pieces of information. This information only needs to be entered one time — the LX200 remembers data even when the power is off. Note, however, that the time should be checked and reset, if necessary, on each observing session.

b. Location of the Observing Site

NOTE: The SITE information cannot be entered if the telescope is in LAND mode.

If the telescope is in LAND mode, the SITE menu option (Display 2) will appear in lower case letters (see **Which Alignment**

Method to Use?, page 13). Follow steps 4 through 8 in **Setting Up the Telescope**, page 11, to change the telescope's operation to Altazimuth (ALTAZ) mode before proceeding.

You should find the position of your observing site to within 1 or 2 minutes of arc in both latitude and longitude. Many automobile, pilot, and topographical maps, as well as most atlases show latitude and longitude in 15 minute increments or better. The accuracy of the LX200 will depend on how close you get, so take a little time to get as accurate as you can.

Once the above information is determined, it can be entered into the telescope. It is easiest to enter the data with the telescope sitting on a table indoors—do not try to do it outside at night.

Each step below is given without any details or explanations to keep the process as simple and fast as possible. Next to each step will also be a sample of what the keypad hand controller display (1, Fig. 6) should look like after each step.

As an example, we will enter the data for Irvine, CA (LAT = 33°35', LONG = 117°42'). If at any time you get "lost," simply turn off the telescope and restart this procedure.

1. Turn the telescope power on. After a few seconds (after the self-diagnostic test is complete), the display will look like Display 1.

Display 1

→ TELESCOPE
OBJECT LIBRARY

2. Press the ENTER key. This selects the TELESCOPE functions. The display should now look like Display 2.

Display 2

→ 1) SITE
2) ALIGN

3. Press the ENTER key. This selects the SITE functions. The display should look like Display 3.

Display 3

→ 1) A A A ✓
2) A A A

4. Press and Hold the ENTER key until the keypad hand controller beeps. This selects the first site for editing. The display should look like Display 4, with the first "A" flashing.

Display 4

→ 1) A A A ✓
2) A A A

5. Press the ENTER key. The display should now look like Display 5.

Display 5

→ LAT = +00° 00'
LONG = 000° 00'

6. Use the number keys to enter your latitude. The underline designates the current cursor position. Mistakes can be corrected by moving back (using the "E" and "W" keys). A negative latitude can be entered by positioning the cursor under the "+" and hitting the "NEXT" key (lower right-hand key). When the latitude is correct, press ENTER. The display will look like Display 6.

Display 6

→ LAT = +33° 35'
LONG = 000° 00'

7. Use the number keys to enter your Longitude as above. When complete, the display will look like Display 7.

Display 7

→ LAT = +33° 35'
LONG = 117° 42'

8. Press ENTER to complete the site information input. The display will go back to Display 3.
9. Press MODE to go back to Display 2.
10. Press MODE again to go back to Display 1.

It is important to note that the longitude standard used in the LX200 starts at 0 degrees in Greenwich U.K. and increases Westerly only to 359 degrees 59 minutes. Many maps will show Easterly longitudes which cannot be entered into the keypad display. As an example, if your map indicates that you are at an Easterly longitude of 18 degrees 27 minutes, then you would enter 341 degrees 33 minutes.

Do not concern yourself with differences in longitude and latitude as they pertain to different map spheroid projections, those minor differences are too small to adversely affect the longitude and latitude data input.

c. Local Time and Date.

NOTE: The Time function on the 16" LX200 telescope is a standard quartz clock. Like nearly any timepiece, the internal clock of the telescope should be periodically checked and updated to keep it as accurate as possible.

The local time should be set as accurately as possible, using the 24 hour format. The local time and date are used to determine sidereal time (star time) and the pointing accuracy of the telescope will depend on the accuracy of the time entered. Choose a reliable source as a reference for accurate time such as your local airport, or telephone company. In the U.S.A. you can double check the accuracy of the exact minutes by dialing WWV for the universal coordinated time at (303) 499-7111 (be sure to enter your local time hour information, not the U.T. hour). For the example, we will use 2:40:00 P.M. on August 5, 1998.

1. The display should look like Display 1. If it does not, press the MODE key until it does.
2. Press the MODE key twice. The display will look like Display 8, but with a random LOCAL and SIDE times.

Display 8

→LOCAL = 11:24:30
SIDE = 21:38:02

3. Press and HOLD the ENTER key until the keypad hand controller beeps (display like Display 9).

Display 9

→LOCAL = 11:24:30
SIDE = 21:38:02

4. Using the number keys, enter the current local time to within 5 seconds. (Remember, 2:40:00 P.M. is 14:40:00 in the 24 hour format.) Corrections can be made by moving the flashing cursor using the W and E keys. The display should look like Display 10. (*NOTE: The time should be checked and reset about once a month.*)

Display 10

→LOCAL = 14:40:00
SIDE = 21:38:02

5. Press the ENTER key when the time is correct. The display will change to Display 11.

Display 11

Hours from GMT:
+ 08

The next step is to enter the Greenwich Mean Time (GMT) time zone shift (This procedure is a lot easier than it sounds). Simply look up your time zone in the table below to find the GMT time zone shift.

U.S.A. TIME ZONES		
TIME ZONE	STANDARD TIME	DAYLIGHT TIME
HAWAII	+10 Hours	+9 Hours
PACIFIC	+8 Hours	+7 Hours
MOUNTAIN	+7 Hours	+6 Hours
CENTRAL	+6 Hours	+5 Hours
EASTERN	+5 Hours	+ 4 Hours
ATLANTIC	+4 Hours	+3 Hours

For example: You live in the Pacific Time Zone and you are on Daylight Time. The GMT time shift is +7 hours.

6. Use the number keys to enter the GMT time zone shift determined from the table above. Press ENTER when done; the display will go back to Display 8. If you are using the LX200 East of Greenwich U.K., then you must enter a - (minus) GMT time zone shift by moving the blinking cursor backwards in the display with the W key and then pressing the NEXT key. The + (plus) sign will change to - (minus). Use the number keys to enter the Westerly (+) GMT time zone shift determined from the table above or your calculated Easterly (-) time zone shift.
7. Press the ENTER key. This will select the DATE display (Display 12), with a random date showing.

Display 12

DATE = 07/11/91

8. Press and Hold the ENTER key until the keypad hand controller beeps. The display will look like Display 13, with the blinking cursor over the first number.

Display 13

DATE = 07/11/91

9. Use the number keys to enter the current date. The display should look like Display 14. Use the W and E keys to move the blinking cursor left and right to correct any mistakes.

Display 14

DATE = 08/05/98

10. Press the ENTER key when the date is correct.

After you press the ENTER key, the keypad hand controller will display "Updating planetary data." The position of the planets depends on the date, so anytime the date is changed, the planet positions are recalculated.

This is all the information the LX200 needs to make use of all features. The next steps actually align the telescope with the night sky.

d. Setting Up the Telescope

After the basic information has been entered into the telescope, the telescope is ready to actually set-up and use. Follow **TELESCOPE ASSEMBLY** (page 6) to set-up the telescope outside, and follow these steps:

1. Using the Bubble Level (14, Fig. 1) located on the telescope's drive base, level the telescope. This is a very important step because the telescope's pointing ability depends on the telescope being level. Make sure the bubble is precisely centered by adjusting the height of the three tripod legs.
2. Loosen the Dec. lock knob (18, Fig. 1) and position the optical tube assembly approximately level (so that the Dec. Circle (3, Fig. 1) reads 0°. Retighten the Dec. lock knob.

- Loosen the R.A. lock (7, Fig. 1) and rotate the telescope so that the R.A. pointer (9, Fig. 1) and the HA pointer (16, Fig. 1) are approximately in line with each other. This will position the fork arms so that they are parallel to the power panel (11, Fig. 1). lock the R.A. lock.

Steps 2 and 3 are not required for the telescope to work, so don't worry about getting it exactly right. The telescope has some "illegal" positions (places where the telescope will not go) and these two steps insure proper operation.

- Turn the telescope on. After a few seconds (after the self-diagnostic test is complete), the display will look like Display 15.

Display 15

→TELESCOPE
OBJECT LIBRARY

- Press the ENTER key. This selects the TELESCOPE functions. The display should look like Display 16.

Display 16

→1) SITE
2) ALIGN

- Press the NEXT key. This will move the arrow to the lower line (see Display 17).

Display 17

1) SITE
→2) ALIGN

- Press the ENTER key to select the ALIGN function. The display will look like Display 18. (If the display looks like Display 19 — with a checkmark already next to ALTAZ, go to step 9.)

Display 18

→1) ALTAZ
2) POLAR

- Press the ENTER key to activate the ALTAZ mode. The keypad hand controller will beep and display a checkmark next to the ALTAZ (see Display 19).

Display 19

→1) ALTAZ ✓
2) POLAR

- Press the ENTER key to use the checked mode (ALTAZ). The keypad hand controller display will look like Display 20.

Display 20

1 Star or
2 Star Alignment

- Press "1" to select "Star." The display screen will now look like Display 21.

Display 21

Level base, then
press ENTER

- If you have not already leveled the telescope, do so now. When the telescope is level, press ENTER. The display will look like Display 22.

Display 22

Press ENTER, then
pick align star

- This message simply reminds you what you should do next. Press ENTER to show a display like Display 23.

Display 23

→ACHERNAR
ACRUX A

- Using the monthly star charts (APPENDIX B, page 29) pick an alignment star. Look at the chart for the current month and face the direction indicated. The constellations shown are easily found — even in the city. The charts are approximately 90 degrees wide, with the top of the chart indicating straight up. If the time is after 9:00 PM, then

use the next month's chart. Once you identify the constellation, pick any of the labeled stars that is not within a 10 degree radius of overhead, but do not choose Polaris, for reasons made clear below. Polaris is also known as the North Star, and is shown for reference only.

When aligning in ALTAZ, overhead stars can confuse the LX200 because of an illegal position that prevents the optical tube assembly from slewing past 90 degrees altitude to protect the viewfinder from hitting the fork arm. The LX200 will track an overhead object, but it does so by moving higher in altitude up to the illegal position, then the drive speeds up and move 180 degrees in azimuth so that the optical tube assembly can now be lowered in altitude to keep up with the overhead object. Confusion arises because the LX200 does not know which side of 180 degrees of azimuth that it is on. Similarly, Polaris presents position problems in ALTAZ alignment because it is so close to the North Celestial Pole. In this region of the sky, the lines of Right Ascension are so close together that even the LX200's high-resolution encoders can yield ambiguous data.

In our example of August 5, we would use the August chart, face North and look up about 45 degrees. Cygnus is probably the easiest constellation to recognize, and we will use the star Deneb for our example.

Use the PREV and NEXT key to scroll through the list of alignment stars until the arrow is positioned on Deneb (Display 24).

Display 24

CASTOR A
→DENE B

The TELESCOPE and OBJECT LIBRARY features are accessed through a series of menus, which are shown on the keypad hand controller display. You can scroll up or down through the list of choices by using the PREV and NEXT keys, and select the indicated menu option with the ENTER key. Menu choices that are shown in lower case letters are unavailable in the current operating mode (LAND, ALTAZ, or POLAR). If you try to select a lower case menu option, the keypad hand controller will emit three warning beeps. Three beeps always indicate an attempt to perform an invalid telescope operation.

- Press the ENTER key to select Deneb. The keypad hand controller displays a message (Display 25).

Display 25

Center DENE B
then press ENTER

- Center the alignment star (Deneb in our example) in the eyepiece of the telescope. You can manually move the telescope by loosening the Dec. lock knob and R.A. lock or electrically by using the N, S, W, and E keys. If moving the telescope electrically, be sure to use the speed keys, SLEW to get close, FIND to center in the viewfinder, and CNTR to center the star in the eyepiece. When the star is centered, press ENTER.

The telescope is now aligned and fully functional, and automatically begins to track objects. From this point on, make all telescope movements using of the keypad hand controller. Manual movements by loosening the Dec. or R.A. locks will cause the LX200 to "lose" position, requiring realignment.

e. Using the MODE Key

The LX200 has 5 basic keypad hand controller displays, and the MODE key is used to move between them. The 5 modes are:

- Telescope Functions.** The TELESCOPE mode is where all telescope functions are changed or activated and the OBJECT LIBRARY is where the features of the object library are accessed.

2. **Telescope Position.** The first display shows the RA and DEC (telescope position in stellar coordinates) and the second display (accessed by pressing the ENTER key) shows the telescope position in ALTaz coordinates.
3. **Time and Date.** The first display shows local and Sidereal time and the second display (accessed by pressing the ENTER key) shows the date.
4. **Timer and Freq.** This display is a countdown timer and allows the user to change drive rates. These are advanced features.
5. **All Off.** This mode simply turns off all displays and backlighting. You can also adjust the backlighting brightness by pressing the ENTER key and using the PREV and NEXT keys to adjust the brightness.

f. Library Object Keys

While in any of the 5 main keypad display modes, you can directly access the library objects by using the M, STAR, or CNGC keys (see **APPENDIX C**, page 31, of this manual for more information on the 64,359 Object Library). Simply press an object key, and type in the number of the object desired, followed by ENTER. For example, a good first object for the first part of the year is M42 — the Great Orion Nebula.

Press the M key, the 4 key, the 2 key, and finally the ENTER key. The display will show data on the object (name, rating, object type, brightness, size). Now press GO TO. The telescope will automatically slew to M42.

If the object entered is not above the horizon, the keypad hand controller will display the message “Object Below Horizon.”

Other good first objects (if above the horizon) are any of the M objects — from M1 to M 110, and the planets. To find a planet enter: (NOTE: 903 is the Moon.)

OBJECT LIBRARY PLANET LEGEND			
PLANET	STAR #	PLANET	STAR#
MERCURY	901	SATURN	906
VENUS	902	URANUS	907
MARS	904	NEPTUNE	908
JUPITER	905	PLUTO	909

4. Star Alignment

The 2-Star initialization routines provide three options for aligning the LX200 telescope when in the ALTaz mode.

*NOTE: The 2-Star initialization routines only apply to the ALTaz alignment mode (see **MODE FUNCTIONS**, page 16, for POLAR and LAND mode initialization).*

The first and second options require that entry of the SITE and TIME information as described in **Entering Basic Information** (page 10). The third option is used when the SITE information is not known or has not been entered into the LX200's memory.

a. 1-Star with Known SITE

The 1-Star alignment routine was explained in detail in **Setting Up the Telescope** (page 11).

b. 2-Star at Known SITE

To use the 2-Star alignment procedure at a known site, follow these steps:

1. Select the 2-Star alignment (by pressing the “2” key); the keypad display will prompt you to level the base. This leveling step requires a rough level only and, unlike the 1-Star alignment routine, does not affect the pointing accuracy of the telescope. (See Section d. below for a summary of the differences in telescope operation when selecting each of the three alignment procedures.)
2. After leveling the base and pressing ENTER, follow the keypad display prompts to select the first alignment star. Slew to that star using the N, S, E, and W keys.

3. Follow the keypad display prompts to choose and center the the second alignment star. Be sure to use the keypad to slew to the second star. After pressing the ENTER key in the last step, the keypad display should show the TELESCOPE/OBJECT LIBRARY screen.

Important Note: *Whenever using either of the 2-Star alignment procedures (at a known SITE or at an unknown SITE), choosing the proper two stars will determine the pointing accuracy of the telescope. Choose two stars that are not too close together — try to use stars that are at least 90° apart. Do not use Polaris because RA changes very fast at the Pole and minor centering errors translate to large RA pointing errors. Also, avoid stars near the zenith (straight up) since azimuth changes very fast in this area. Generally speaking, choosing two stars as far apart as possible will yield very accurate pointing, often within a few arc minutes.*

The LX200 calculates the distance between the two stars that you chose in the alignment steps and compares this to the distance that you actually slewed the telescope. This is a check to be sure you centered the correct stars during the alignment steps. Should the LX200 discover a discrepancy, the keypad will display an “Align Mismatch — Check Stars” message. If you get this message after aligning the telescope, check that you are using the correct stars and align again.

c. Unknown SITE

To use the LX200 telescope at an unknown location, use the following procedure:

1. Select site #5 (UNKNOWN) from the SITE menu.

*NOTE: This site cannot be edited like site numbers 1 to 4 as described in **Entering Basic Information**, page 10.*

2. Follow the keypad display prompts to select and center the two alignment stars.

As described above, the LX200 will check the accuracy of the two stars and give the “Align Mismatch — Check Stars” message if it detects an error.

d. Which Alignment Method to Use?

Each of the three method described above has advantages and disadvantages. The following table summarizes these properties.

	1-Star Known	2-Star Known	2-Star Unknown
Pointing Accuracy Determined By:	Level of Telescope	2-Star Alignment	2-Star Alignment
Atmospheric Refraction Correction*	Yes	Yes	No
Atmospheric Refraction Correction Determined By:	Level of Telescope	Level of Telescope	Not Applicable
When Best Used	Best used when the telescope is permanently mounted and accurately leveled	Best used on a transportable telescope with the SITE information available	Best used when the SITE information is not available

* **Atmospheric Refraction Correction:** Light from an astronomical object is “bent,” (refracted) as it passes through the atmosphere. This bending is more pronounced near the horizon because there is more atmosphere for the light to pass through, and it shifts the apparent position of the star. The LX200 calculates this bending and compensates for it when slewing to objects near the horizon.

THE LX200 KEYPAD HAND CONTROLLER

Designed to make you a better astronomer, the integration of optics, mechanics, electronics, and software in the LX200 Maksutov Cassegrain or Schmidt Cassegrain Telescope is easily mastered. So easy, in fact that the telescope becomes a natural extension of the observer.

The LX200 gives you virtually every telescope function possible with every control in a compact hand held console. The red LCD backlit keypad has tactile touch buttons (some of which are brighter than others), designed to have the right feel even if you wear gloves. Its red LCD backlit display, key arrangement, and easy to understand information allow you to focus the telescope and your mind on the subject at hand.

The LX200 keypad hand controller is a dual axis drive corrector with periodic error control; an information display center for the computerized library; a digital coordinate readout system; a pulsing, illuminated reticle eyepiece brightness controller; a two speed electric focuser controller, and a red LED flashlight!

You will find within a few minutes of powering up the LX200 that the keypad becomes warm, which is normal for the system. The electronics utilize a heat sink as a means to provide the correct operating environment temperature for the LCD display even in sub-zero weather. If you are in these colder conditions, the display may not be visible until the keypad has transferred enough heat. This process can take a few minutes upon powering up the telescope. While severe cold weather is not damaging to the electronics, it is advised to keep the keypad in a warmer area to allow immediate proper display performance.

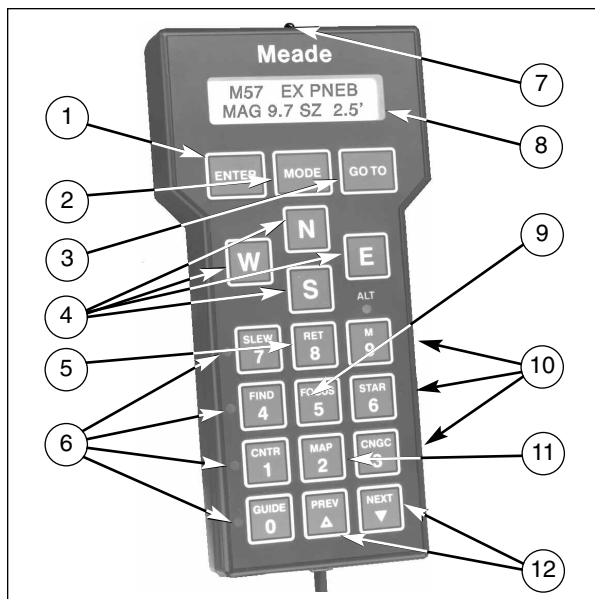


Fig. 6: Keypad Hand Controller. (1) ENTER Key; (2) MODE Key; (3) GO TO Key; (4) Direction Keys; (5) RETURN Key; (6) Speed Keys; (7) Red LED Light; (8) Display; (9) Focus Key; (10) Object Keys; (11) MAP Key; (12) PREVIOUS and NEXT Keys.

The LX200 keypad buttons are described as follows:

1. ENTER Key

The ENTER key (1, Fig. 6) is used to select a menu file, a file option, or to edit a value. To select a file or an option, press and release the ENTER key. The LX200 will give a short beep tone and perform the action that you have requested. To edit a value, press and hold the ENTER key until a double beep tone is heard and a blinking cursor appears in the display. There are some other specific situations where the ENTER key is used. These are described in detail where necessary. From now on, the two types of presses will be called 'press' and 'press and hold.'

2. MODE Key

The MODE key (2, Fig.6) cycles through the five modes of the LX200, and is used to exit from specific menu files.

3. GO TO Key

The GO TO key (3, Fig. 6) causes the LX200 to automatically slew to specific library entry coordinates. The GO TO key also produces a blinking cursor in the GO TO menu file of the COORDINATES/GO TO mode, to allow new Right Ascension and Declination coordinates to be entered.

4. Direction Keys

Labeled N, S, E, and W, (4, Fig. 6) these four keys make the LX200 move, or slew, in a specific direction, with an option of four different speeds, explained later. During entry to change a value, the E and W keys can be used to move the blinking cursor back and forth across the LCD display, so that if an error is made during entry, it can be erased and changed.

The remaining 12 keys have multiple functions, there are up and down arrow keys, and numbered keys from 0 through 9. Each one of these keys also has alternate functions listed above the arrow symbols and numbers. The ALT LED light is only visible when entering numerical data. A description of the individual keys follows:

5. Speed Keys (SLEW, FIND, CENTER, and GUIDE)

These keys (6, Fig. 6) allow you to set the rate of movement (slew) speed in the drives of the LX200, as activated by the N, S, E, and W keys. The chosen rate is indicated by the speed indicator illuminated LED beside the rate key that you have pressed. the speed rates are SLEW (4 degrees per second), FIND (1 degrees per second), CNTR (16X sidereal rate), and GUIDE (2X sidereal rate).

NOTE: All of the slew speeds will drive the LX200 in all four directions, except for GUIDE. The 2X sidereal speed in GUIDE has one difference in that it will not interrupt the Right Ascension tracking direction to make Easterly (for Northern hemisphere) or Westerly (for Southern hemisphere) adjustments; it will merely slow down the tracking drive to one half its normal speed. You will find, however, that the slower drive will move the image opposite of the tracking direction, without disturbing the smooth drive action. This performance is absolutely essential when making astrophotographs.

SLEW, FIND, CENTER, and GUIDE keys also have numbers listed 7, 4, 1, and 0 respectively. When editing a value, the multiple function of each of these keys is realized. SLEW and FIND are also used to set the "fast" focus speed for the electric focuser accessory option, while CNTR and GUIDE set the "slow" focus speed. There are other special functions for the CNTR and GUIDE keys that are discussed in the RET KEY operations.

6. RET Key

Typically used for guiding the LX200 during an astrophotograph, the RET key (5, Fig. 6) is used to change the brightness and pulse rate of the optional corded style illuminated reticle eyepiece. Pressing either the PREV and NEXT (up and down arrow) keys while holding down the RET key, alters the reticle brightness level up or down.

When guiding on very faint stars, you may find it helpful to pulse the light from the LED so that the reticle crosshairs blink on and off. You will be able to adjust the reticle brightness as well as adjust the pulse rates. There are three pulse rates that can be used, all with a one second pulse interval. The continuous illumination control and pulse rates are set by holding down the RET key and pressing one of the following keys; GUIDE (100% on, no pulsing), CNTR (50% on, 50% off), MAP (25% on, 75% off), CNGC (10% on, 90% off).

7. FOCUS Key

The FOCUS key (9, Fig. 6) allows 2 speed electric focus control of the optional Meade #1206 Electric Focuser (or equivalent corded electric focusers such as the Meade Model #1200A). To activate, press either the SLEW or FIND key (for fast focusing), or the CNTR or GUIDE key (for slow focusing), press and hold the FOCUS key, and then press and hold the PREV or NEXT keys for near and far focus.

8. MAP Key

The Map key (11, Fig. 6) turns on and off the red LED 'flashlight' that is located at the top of the keypad. The deep red LED light will protect your night vision while you search for a particular accessory or examine a star chart.

9. Object Keys (M, STAR, and CNGC)

These keys (10, Fig. 6) allow direct access to the LX200's Object Library any time that you are not editing a value or setting a parameter, or selecting a file menu. Use the Object keys when you are at a "top level" of a mode. After pressing one of these keys, the keypad's display will give a blinking cursor, allowing you to enter the catalog number for objects listed in the library (see APPENDIX C, page 31). After entry press the ENTER key. To see the entered object press the GO TO key. A brief description of the catalog key symbols are; M (Messier objects), STAR (stars and planets), and CNGC (Computerized New General Catalog).

The 16" LX200 has several object libraries which are accessed with the STAR and CNGC keys.

When you press the STAR or CNGC keys, the display will show which object library you are currently in and wait for a number entry, as described above.

To switch to a different library, press the ENTER key instead of entering a number.

The keypad display will show a menu of libraries available. Move the cursor to the desired library and press ENTER to select.

The 16" LX200 will "remember" the database you last accessed. Each time you press the STAR or CNGC keys, the same object database will be displayed on the first line of the keypad display.

10. PREV AND NEXT Keys

The PREV and NEXT (up and down arrow) keys (12, Fig. 6) move the display LCD arrow up and down the menu files and menu file options, so that you may choose an individual selection to enter. These keys are also used when adjusting the RET brightness range, or when activating the electric focuser. PREV and NEXT work as well to select the objects from the Object Library when using START FIND.

THE LX200 POWER PANEL

The power panel incorporates a power switch and LED indicators showing power on with a current ammeter to show power draw.

The power panel has all of the connectors for the AC or DC power input, the DEC Motor, and the keypad. There are connectors designed to accept optional accessories such as a CCD autoguiding camera, the optional Meade Field De-Rotator, the Meade #1206 Electric Focuser, and an illuminated reticle eyepiece. There is even a connector for RS-232 communication that will allow you to perform every function of the keypad from your personal computer. An illustration and a description of the 16" LX200 power panel features follows:

1. ON/OFF Switch

When the ON/OFF Switch (7, Fig. 7) is moved to the ON position, the power light indicator, the Current Ammeter, and the keypad all light up. You will hear the drive motors rev which momentarily pegs the Ammeter, then the drive motors shift to a slower speed which allows the RA worm gear to find its centering position for calibrating the Smart Drive, then resuming to an even slower tracking speed. The keypad display reads "Meade," then the version of the software is indicated briefly before defaulting to the TELESCOPE/OBJECT LIBRARY. Within 15 seconds, the planetary orbital calculations with their corresponding apparent sizes and magnitudes, and current stellar precession calculations are made. Every computer function is checked, and the LX200 diagnostics are complete.

2. N/S Switch

The recessed N/S Switch (8, Fig.7) converts the LX200 for operation in the Northern or Southern hemisphere, making the drive reverse its' tracking direction. Before power up, the appropriate N or S switch position should be made, as the LX200 will not recognize a change made on the N/S switch afterwards. Use a pen or small tool to slide the switch appropriately. Be sure before you travel across the equator, that you are setting the proper + or - latitude SITE entry for your final destination.

3. Ammeter

The Ammeter display (1, Fig. 7) is a series of vertical red LED bars. Each bar that is fully lit represents 0.3 ampere (300 milliamperes) of current draw. The LED Ammeter represents its lowest value on the extreme left of the scale. During normal tracking speeds, the Ammeter will show about three fully lit LED bars and at times a fourth that is partially lit, indicating about 900 to 1000 milli-amps or 0.9 to 1.0 amps of current draw (when a slew is initiated, the ammeter will peg the scale momentarily showing the inertia load, this effect is entirely normal). The current draw information can be useful if you are trying to calculate how much battery life you will have during an

observing session. As an example, if the ammeter has four bars lit, indicating 1.2 amps and you are using a 12 amp hour battery, then to know the approximate number of hours of life the battery would yield by dividing 12 by 1.2. This indicates a battery life of 10 hours.

4. DEC Motor Connector

The DEC Motor Port (11, Fig. 7) is a DB-9 socket, designed to accept the supplied coil cord. One end of the supplied coil cord plugs in to the power panel and the other plugs into the DEC MOTOR socket in the right fork arm to power the declination motor.



Fig. 7: 16" LX200 Power Panel. (1) Ammeter; (2) RS-232 Connector; (3) Aux Connector; (4) Focuser Connector; (5) Reticle Connector; (6) Keypad Connector; (7) ON/OFF Switch, (8) N/S Switch; (9) 12v DC Power Connector; (10) CCD Connector; (11) DEC Motor Connector.

5. CCD Connector

The CCD Port (10, Fig. 7) allows direct interface from popular aftermarket CCD autoguiding/imaging cameras with their compatible connecting cables to accomplish autoguiding for non-attended astrophotography. The CCD cameras effectively watch a star and detect slight movements. When star movements are detected, signals from the CCD electronics make drive corrections in the LX200, to bring the star to a home position.

Most CCD autoguiding/imaging cameras are supplied with a cable which is compatible with the LX200 port. If your CCD unit does not have a cable, one can be obtained from the CCD manufacturer, or you can make your own cable using the following table of information.

CCD Connector Pin	LX200 Assignment
#1	Normally Closed
#2	West
#3	North
#4	Ground
#5	South
#6	East

6. Power 12 vDC Connector

The power 12 vDC connector (9, Fig. 7) is designed to accept either the standard-equipment AC Converter or the optional DC Power Cord. The acceptable voltage range (under load) is from 12 to 18 volts.

7. Keypad Connector

The keypad connector (6, Fig. 7) is a 4 pin phone jack connector socket, designed to accept standard 4 pin phone jack coil cords. One end of the supplied coil cord plugs into the keypad port, the other end plugs into the LX200 keypad.

8. Reticle Connector

The Reticle connector (5, Fig. 7) accepts optional accessory corded, plug-in style illuminated reticle eyepieces such as the optional Meade 12mm Illuminated Reticle Eyepiece, or the Meade Series 4000 Plössl 9mm Illuminated Reticle Eyepiece (corded style), to allow brightness control and on/off pulsing rates to be set from the LX200 keypad.

9. Focuser Connector

The focuser connector (4, Fig. 7) accepts optional accessory corded, plug in style electric focusers such as the Meade #1206 Electric Focuser, to allow electric focus adjustment control from the LX200 keypad.

10. RS-232 Connector

The RS-232 connector (2, Fig. 7) allows personal computer interface to allow communications at 9600 baud to access every feature of the LX200 keypad. Many popular astronomy programs are available which directly interface with Meade LX200 telescopes, including Epoch 2000sk Sky Software by Meade Instruments Corp. In **APPENDIX F** (page 58) of this manual is a wiring schematic to make your own RS-232 connector cord, a cord test program, a demonstration program, and the LX200 Command Set for writing programs. Meade Instruments supplies this information for professional programmers. Meade Instruments Corporation does not offer support or advice for writing software for the RS-232 option.

11. Aux Connector

The Auxiliary connector (3, Fig. 7) is used for the 7" Maksutov fan power.

MODE FUNCTIONS

To view the separate modes within the LX200 system, press the MODE button located between the ENTER and GO TO keys at the top of the hand controller. Simple entry and editing of information in the different modes contained within the system, will customize the operation of your LX200 to perform virtually any of your observing requirements. Better still, all of the critical information such as time, location, alignment type, and many other functions are kept in memory...even with the LX200 turned off!

The type of alignment, the objects that you see, the location that you observe from, the tracking speeds of the drives, all of the clock and timing functions, the position information, and even the brightness level of the backlit keypad are defined by the information that you give and/ or the commands that you edit, through five different modes of the LX200 computerized hand controller.

Once you have selected the desired mode, you can then select the individual file within the mode by pressing the PREV or NEXT key (up and down arrow key) in the bottom right hand portion of the hand controller, moving the LCD arrow up or down beside the file description. Although you will only be able to see two menu selections at a time in the keypad display, you will see more as you continue to press the PREV and NEXT keys.

When the desired file is chosen, press the ENTER key to view the files menu. To choose an individual menu, again use the PREV or NEXT key to run the LCD arrow up or down the files menu. To explore a menu selection, again press the ENTER key. In some modes there will be options for a files menu selection, in others you will only enter data.

At any time that you wish to return to main file heading in a particular mode, just press MODE and it will behave as an exit key.

1. Mode One: TELESCOPE/ OBJECT LIBRARY

This is the mode that the LX200 will default to after the instrument completes its self-check, when the LX200 is first turned on. The TELESCOPE/OBJECT LIBRARY mode can be thought of as command central. It is here that we can select the way that we want the LX200 to perform mechanically, and where we can explore and select from its extensive library of stored objects.

To explore either the TELESCOPE menu file or the OBJECT LIBRARY menu file, move the LCD arrow to the appropriate selection by using the PREV or the NEXT key and press the ENTER key.

a. TELESCOPE Menu File

Below are the 14 selections of the TELESCOPE menu file, illustrating the individual menu files and file options.

1. **SITE:** The SITE menu option allows you to enter up to four of your favorite viewing locations in longitude and latitude. The entered longitude and latitude is compared by the LX200's computer to your local time, GMT offset, and calendar date to accurately calculate celestial coordinates. Once entered, the information is stored in the telescope's internal memory, you need never re-enter the same information. To enter new site information or to change an old one, see **QUICK START**, page 9.

You can choose any one of the four site options (or the UNKNOWN site) at your convenience, without the bother of entering longitude and latitude every time you use the LX200. Once the site is chosen, exit the SITE menu by pressing the MODE key.

2. **ALIGN:** The Align menu selection of the TELESCOPE file demonstrates the unique ability to transform the LX200 into an Altazimuth, celestial tracking telescope, a polar-equatorial celestial tracking telescope, or land spotting scope with electric Altazimuth movements within three

options, which are; ALTAZ, POLAR, and LAND.

Assuming that you have already entered correct local time, latitude, and longitude (see **QUICK START**, page 9) you are ready to choose a particular type of alignment, by pressing the NEXT or PREV key to run the arrow beside the desired option of ALTAZ, POLAR, or LAND, and then pressing the ENTER key. The display will then give you specific instructions from this point that will literally walk you through the chosen alignment type.

- a. **ALTAZ:** ALTAZ (Altazimuth) requires that you mount the LX200 directly to the top of the field tripod (with the power panel facing North), and adjust the leg extensions of the tripod until the instrument is level. You are then required to align on one or two of the bright stars in its look up table of 33 alignment stars. This allows your LX200 to track in altitude and azimuth simultaneously for visual observations, or very brief (under five minutes) exposure astrophotography or CCD imaging (longer exposures will require the Field De-Rotator). ALTAZ allows you to fully access the Object Library as well as all other telescope functions. Complete instructions for using ALTAZ are in the **QUICK START** (page 9).
- b. **POLAR:** POLAR allows you to use the 16" LX200 (mounted on a permanent pier set to your latitude) as an equatorial telescope. With the LX200 powered up, the POLAR file option selected, and the field tripod leveled, the telescope should be adjusted so that the Declination setting circle (3, Fig. 1) is set to 90 degrees and the telescope is rotated to the 00 hour angle (HA) position in Right Ascension. In this position, the viewfinder (Fig. 1) is up-side down, and the R.A. pointer (4, Fig. 5), the 00 line of the R.A. setting circle (3, Fig. 5), and the HA pointer (5, Fig. 5) all line up. (If you do not start at the 00 H.A. position, the telescope will point to the ground instead of the sky, when the keypad display chooses its second star.) Press the ENTER key and the LX200 will determine and slew to the precise off-set of the pole star in Declination and Right Ascension.

At this point you need only aim the instrument at the pole star (see **APPENDIX C**, page 31, if the pole star is not visible) and center it in the eyepiece field using only the altitude and azimuth adjustments on the pier. Once done, you again press the ENTER key and the LX200 will choose and slew to a very bright star that is overhead and can usually be seen in the field of view of the viewfinder. At this point, center the bright star using only the Right Ascension and Declination adjustments of the telescope (either manually by loosening the locks only or electrically), then press ENTER. You can now access every every function of the LX200.

- c. **Refined Polar Alignment:** Astrophotographers routinely require polar alignments of the highest accuracy for the finest guiding characteristics. Your initial polar alignment can be refined by using the LX200's electronics by using a slightly different method in the POLAR menu option. The steps outlined below should be performed in two or three 15 minute intervals. At each interval the telescope will slew to the area where the pole star should be centered in the optics. You may find that the pole star is somewhat off-center in the eyepiece showing the alignment error that may have been made during your initial setup. Re-center the pole star during each interval using the tripod adjustments only (see **APPENDIX B**, page 29) in altitude and azimuth, then follow the rest of the routine.

Return to the POLAR menu option in the

TELESCOPE mode and press the ENTER key.

Ignore the keypad display instructions to return the telescope to 90 degrees in Declination and 00 HA. Instead, press the GO TO key and the LX200 will slew to the calculated position of where the pole star should be.

Re-center the pole star in the field of view in the eyepiece using only the adjustments on the pier in altitude and azimuth.

Press the ENTER key, and the LX200 will once again slew to a bright star overhead. Center this star using the N, S, E, or W keys, then press ENTER.

NOTE: Pressing the MODE key at any point in the alignment routine aborts the routine and exit to the top menu.

After each 15 minute interval you will find that the pole star becomes more accurately centered each time. You can repeat the intervals as often as you like to obtain the highest accuracy. An optional illuminated reticle crosshair eyepiece makes the job of centering the star easy.

There may be situations when it is impossible to see the pole star due to something blocking your line of sight. On such an occasion, just press the ENTER key for the POLAR option so that it has a check next to it, then follow the instructions in **Precise Polar Alignment**, page 30. You will require the use of an illuminated reticle crosshair eyepiece* to complete the task. Once finished, follow the steps below for a permanently mounted LX200 section to access the Object Library.

- d. **The Permanently Mounted, Polar Aligned LX200:** For those who will permanently mount the LX200 in an observatory, or wish to use the already polar aligned telescope for several nights in succession, it is recommended that a high precision polar alignment be made with one of the methods described above. Once done, however, you need not bother yourself to go through a polar alignment routine on successive nights (provided that you do not move the instrument on the pier) to access the Object Library and enjoy near perfect tracking.

To bypass the polar alignment sequence, follow the steps outlined below:

- Return to the POLAR menu option and place a check next to it by pressing the ENTER key.
- Then directly enter the catalog number of an object that you are familiar with in the sky by pressing the M, STAR, or CNGC key (see **APPENDIX D**, page 34, for information on the Object Library) and press the ENTER key again.
- Manually center the familiar object in the eyepiece of the telescope.
- Press and hold the ENTER key until the display reads "Coordinates matched."

You have now synchronized the Object Library and the LX200 will correctly access every other object in the sky.

- e. **LAND:** The LAND menu option transforms the ALTAZ (Altazimuth) mounted LX200 into an electric slewing spotting scope. In this mode, continuous tracking is canceled and all of the celestial modes and menus are non-functional, showing lower case lettering in the displays and a beep tone if you try to enter one of them.

The LX200 will slew at any one of the four speeds of SLEW, FIND, CNTR, and GUIDE as activated by pressing the appropriately marked keys on the left

side of the keypad. Altazimuth coordinate readings can still be displayed in the coordinates mode (see **MODE 2**, page 22). Refer to **QUICK START** (page 9) for the **LAND** menu option, for full operating procedures. You will also find that the addition of the Meade #928 45-Degree Erect Image Prism or the Meade #924 Porro Prism instead of the standard supplied star diagonal prism, will give the normal right-side-up and left-to-right views that you are accustomed to when using a spotting scope.

3. **SMART:** The SMART menu file controls the Smart Drive and allows you to train almost all of the periodic error from the Right Ascension drive worm gear (errors induced by tiny gear imperfections that tend to slightly speed up or slow down the drive tracking speed, that occur in a regular 8 minute pattern, or for every rotation of the worm) for greatly enhancing the tracking characteristics or the amount of East and West drift of your LX200. This greatly simplifies guiding during astrophotography. The menu also has provisions for correcting Declination drift. Smart Drive will retain the training given to the R/A drive, even after the telescope is turned off. There is of course a way to erase any training given to it at your command.

The SMART menu has five options. They are; LEARN, UPDATE, ERASE, DEC LEARN, and DEC CORRECT. To use the Smart Drive, the LX200 must be mounted with the optional equatorial wedge (see **APPENDIX A**, page 25), equipped with an illuminated reticle eyepiece*, and used in the POLAR align menu selection. Be sure to train the Smart Drive in the 60.1 Hz Quartz setting that the LX200 will be automatically set at power up. Thereafter, you can adjust this setting in the TIMER/ FREQ mode and still enjoy the periodic error correction.

Once a polar alignment has been completed, your LX200 will point to a bright star overhead that will be near the Celestial Equator. This will be a good star to train the Smart Drive on. You can of course, move to another star just as long as you are near 0 degrees in declination and more or less overhead in Right Ascension. Now is good time to set the brightness and/ or the pulse rate (see **THE LX200 KEYPAD HAND CONTROLLER**, page 14) of the illuminated reticle on the guide star and practice guiding for a few minutes.

To actually begin training the Smart Drive, move the LCD arrow to LEARN by using the PREV or NEXT key and press ENTER. There will be numbers that will appear next to the LEARN display, that will begin counting down to zero. The highest number that can appear is 240. The period of the worm is eight minutes and the number represents a sector of the worm wheel which will change to the next lower digit every two seconds. As the keypad display approaches sector 5, an alarm will alert you that training is about to commence. At this point try to keep the star on the same location of the crosshair during the eight minute training sequence by pressing the N, S, E, and W keys. After eight minutes, the training is over and Smart Drive will play back the drive corrections automatically, dramatically improving the R.A. drive tracking.

If you wish to further refine the accuracy, move the LCD arrow to UPDATE and press ENTER and follow the same instructions as above. This can be done in UPDATE as many times as you wish. With each training the Smart Drive will average your training sequences.

If you find that you have made a mistake in training (e.g. pushed E instead of W when you should have), you can eliminate the memory by moving the LCD arrow to ERASE and press ENTER.

A star that drifts consistently North or South during guiding, can also be corrected for. Move the LCD arrow to DEC LEARN and press ENTER. Begin making drive

corrections immediately by pressing any of the direction (N, S, E, W) keys to keep the star on the crosshair of the guiding eyepiece. It is suggested that you train in DEC LEARN for at least half of your intended exposure time for an astrophoto. The longer that you train, the more accurate the DEC LEARN will be. Once the desired time is finished, press ENTER and the training will cease. The Smart Drive will then determine how many key pushes that you gave in N and S and choose the direction based from which direction received more commands. It then averages the time between key pushes in the chosen direction. In this way, the Smart Drive can correct for Declination drift (should your polar alignment be slightly off), or will allow you to more precisely guide on non-stellar objects, such as comets, asteroids, etc.

To play back your DEC LEARN training, move the LCD arrow to DEC CORRECT and press ENTER. To halt the play back press ENTER again. To erase the DEC LEARN training, either move the LCD arrow back to DEC LEARN and press ENTER twice or turn the LX200 off.

4. **12/24 HR:** The 12/24 HR menu selection of the TELESCOPE file simply toggles between a 12 and 24 hour display of local time in the time mode.

To toggle between 12 and 24 hours displays, move the arrow to 12/24HR and press ENTER. To return to the original setting, press ENTER again.

5. **HELP:** The HELP menu selection of the TELESCOPE file is an electronic mini-manual that will briefly describe the function of each command key on the LX200 keypad.

To use this menu, move the arrow with the PREV or NEXT key to HELP and press ENTER. To read the lines of text, use the PREV and NEXT keys. To exit, press MODE.

6. **REVERSE N/S:** The REVERSE N/S menu selection of the TELESCOPE file reverses the direction of the telescope in North and South movements (e.g., when you press the N key the scope will move South or down instead of North or up). This is especially useful during some guiding applications in imaging and observing.

To use the REVERSE N/S menu, move the arrow to REVERSE N/S and press ENTER. If you wish to return the direction commands to the original setting, press ENTER again.

7. **REVERSE E/W:** The REVERSE E/W menu selection of the TELESCOPE file reverses the direction of the telescope in East and West movements (e.g., when you press the W key, the telescope will move East instead of West).

To use the REVERSE E/W menu, move the arrow to REVERSE E/W and press ENTER. If you wish to return the direction commands to the original setting, press ENTER again.

8. **BALANCE:** When adding optional equipment to the LX200, like a heavy camera, it is often necessary to rebalance the telescope using the Meade #1404 Tube Balance Weight Systems.

Selecting option #8 from the TELESCOPE menu moves the LX200 telescope rapidly up and down in Declination. This provides an easy way to determine when the telescope is balanced in the Declination axis. (Remember, loosening the Dec. lock to check the balance will cause the LX200 to lose alignment.)

When the telescope is out of balance, the LX200 will draw more current when slewing in the "heavy" direction and the Dec. motor will sound different.

After selecting option #8, watch the Ammeter and listen to the Declination motor to determine when the LX200 is balanced.

9. **HI-PRECISION:** The High-Precision Pointing feature of LX200 allows for very precise pointing of the telescope. By incorporating the unique LX200 SYNC command, 0.3 arc-sec resolution encoders, and high-speed DC servo motors, observers can now place objects in the telescope's field of view with 1 arc-minute or better pointing accuracy. This makes critical image placement applications, such as CCD imaging, possible.

Normal telescope pointing accuracy is better than 5 arc-minutes when doing a casual alignment, which is more than accurate enough for most observing applications. (A "casual" alignment is one that uses the UNKNOWN SITE or one that is done without the use of a reticle eyepiece to exactly center the alignment stars.) This type of alignment will put objects into the field of view of most eyepieces and is more than adequate for almost any visual observing application.

A "critical" alignment will improve the pointing accuracy of the telescope to 2 arc-minutes or better. This type of alignment requires accurate SITE information, time, date, proper selection of the two alignment stars, and a reticle eyepiece to exactly center the alignment stars. These steps generally require only a few extra seconds to accomplish, and will improve the telescope's positioning by a substantial amount. Using the "critical" alignment will provide telescope positioning suitable for all but the most demanding pointing applications — including CCD imaging with larger chip cameras, like the Meade Pictor 416 and Pictor 1616 CCD cameras.

The HI-PRECISION feature increases the pointing accuracy of the LX200 to 1 arc-minute or better and also requires the "critical" alignment described above. This will yield the best pointing accuracy possible, placing objects onto the active area of the even the smallest CCD cameras available.

It should be stressed that for most applications, using the HP feature is NOT required to get maximum enjoyment out of the telescope. For an evening of simple visual observations, the "casual" alignment is all that is required. Don't let the pointing precision of the telescope become more important than the fun of observing the night sky!

The High-Precision Pointing mode requires the "critical" alignment, described above, to maximize the telescope's pointing ability. The LX200 default condition is with HP disabled. To activate the HP mode, select the "hi-precision" option from the TELESCOPE menu (option #9). When selected, "HI-PRECISION" will change to upper case letters.

When HP is active, the LX200 automatically does several things whenever a GO TO is initiated.

- a. HP will search the alignment star database and find the three closest stars to the object (or position) entered. This process takes about 10 seconds and the keypad will show Display 26:

Display 26

**HI-PRECISION
Searching. . .**

- b. The telescope will slew to the nearest alignment star. These are all bright (brighter than 3rd magnitude) stars and far enough apart to insure that there will only be one in the field of view. The keypad display will show Display 27:

Display 27

**Center STAR XXX
then press GO TO**

Using a reticle eyepiece, center the star in the field of view. (Or center the star on the CCD chip if using a CCD camera.) Press GO TO when the star is centered.

NOTE: If this star is not in the field of view or if it is obstructed by a land object, the other two stars are available. Use the PREV and NEXT keys to cycle through the three closest stars.

- c. The telescope will slew to the selected object or position.
10. **SLEW RATE:** Option #10 in the TELESCOPE menu is for changing the slew rate of the LX200 telescope. Slowing down the slew rate will result in less noise as the telescope moves and will also use a little less power. To change the slew rate, follow these steps:
- a. Press the MODE key on the keypad until the TELESCOPE/OBJECT LIBRARY menu appears. The cursor should be next to the TELESCOPE option — if not, press the PREV key to move the cursor up one space.
 - b. Press ENTER to select the TELESCOPE functions.
 - c. Press the PREV or NEXT keys to move the cursor to option #10: SLEW RATE. On the right hand part of the display, the number 4 is displayed. This represents the current slew rate in degrees per second.
 - d. Press the ENTER key to change the slew rate. Each successive ENTER key press increments the slew rate by 1 degree per second.
 - e. After setting the desired rate, press the MODE key to return to the TELESCOPE/OBJECT LIBRARY menu.

NOTE: The slew rate is NOT stored in permanent memory and needs to be reset each time the telescope is powered up. The default slew rate is 4 degrees per second.

11. **BACKLASH:** The Backlash feature is only available in the POLAR mode.

When taking long exposure astrophotographs, it is necessary to "guide" the photograph to make sure the telescope is tracking perfectly, otherwise stars will appear as ovals instead of pinpoints. This is done by setting the LX200 keypad to the GUIDE speed, monitoring the star location (e.g. with an off-axis guider), and making small corrections to the telescope position by using the N, S, E, and W keys.

When making these corrections, the R.A. motor will speed up or slow down (by pressing the "E" and "W" keys). The Declination motor, however, when activated (by pressing the "N" and "S" keys) will actually stop and reverse direction. Because of backlash in the Declination motor gearbox, there will be a few seconds delay before the telescope begins to move when reversing direction.

The Dec. backlash feature compensates for the Dec. motor gearbox backlash and provides instant telescope movement when the motor is reversed.

To program the Dec. backlash, use this procedure:

- a. Move to option #11 from the TELESCOPE menu. The keypad display will show:

"11) BACKLASH 00"

The "00" in the display shows the number of arc-seconds of backlash the LX200 is set to compensate for (the default setting is 0 arc-seconds).

- b. While observing a star at high power, time the Declination movement delay when reversing the motor directions (by pressing the "N" and "S" keys). Typical values are 2 to 4 seconds.
- c. The GUIDE speed for the Declination motor is 15 arc-seconds per second. Therefore, multiply the number of seconds delay by 15.
- d. Press and hold the ENTER key for 1 second. The keypad will beep and a blinking cursor will appear on the keypad display. Enter the number determined in

step c, above. Press ENTER when the number is entered.

- e. Check the time delay as described in step b. If there is a delay, increase the compensation number. If there is a slight jump when reversing direction, then the number is too large.

When the compensation number is correct, the LX200 telescope will move almost instantly when reversing the direction in Declination. This compensation feature also works in conjunction with popular CCD autoguiders, allowing for more accurate autoguiding.

This number is stored in permanent memory and should never need to be set again.

b. OBJECT LIBRARY Menu File

The OBJECT LIBRARY menu file is the other half of the TELESCOPE/OBJECT LIBRARY mode. With it you can become a tourist of the sky, or conduct research surveys of the 64,359 objects. The LX200 Object Library is accessible in the most results-getting, user friendly system ever designed for observers and astrophotographers.

The core library, essentially a "greatest hits of the sky," encompasses eight planets of our solar system from Mercury to Pluto, 351 stars (doubles, variables, pole stars), the entire Messier catalog of 110 objects, 7840 of the finest galaxies, diffuse and planetary nebulae, and globular and open star clusters

The position epoch of these objects is for real time, updated each time you turn on your LX200. Even the planet's positions have their orbits calculated! This not only qualifies the LX200 as the most accurate integrated object library available, it will never require updated software for precession of the stars or planetary orbital changes.

There are three primary ways to use the Object Library. You can directly access the library by using the M, STAR, or CNGC keys (see **THE LX200 KEYPAD HAND CONTROLLER**, page 14) and entering a specific catalog number, the START FIND option can be used to logically find objects in organized strips of the sky that can be custom tailored to only show the objects you wish to see with a selection of object types, size brightness, etc., or you can scan the sky and have the Object Library tell you what is in the field of view in the eyepiece by using the FIELD option. Below is a description of the four OBJECT LIBRARY menu files and file options:

To access the OBJECT LIBRARY menu file, move the arrow to the OBJECT LIBRARY display by pressing the PREV or NEXT key while in the TELESCOPE/OBJECT LIBRARY mode and press the ENTER key. Now you can access the four menu selections within the OBJECT LIBRARY by moving the arrow to the desired menu selection by using the PREV or NEXT keys and doing the following steps.

1. **OBJECT INFO:** Press the ENTER key to read the type, brightness, size, and quality. Press ENTER again to read the coordinates. Press ENTER once more to determine how far off the telescope is pointing from the entered object (this is displayed in LCD bars, each bar is ten degrees, or if it is on the object, no bars). This same information can also be accessed at any time by pressing the ENTER key for any object entered by the M, STAR, or CNGC keys. Press MODE to exit to the main menu file.
2. **START FIND:** The START FIND option resources the CNGC objects within the Object Library and begins a logical search starting wherever the telescope is positioned when activated. To cover the entire visible sky it will make 31 strip divisions about 12° wide, moving from West to East, from the North Pole to the South Pole, then South to North. Once it has found all of the CNGC objects it will repeat its sequence until new objects are visible.

Press the ENTER key and the hand control will display the first object in its finding sequence. This first object is selected by the LX200, based off of where the instrument is pointing in the sky when you entered START FIND. To point your LX200 to the object displayed, press the GO TO key and it will slew to the object.

While in the START FIND option, you can either choose the next object in line or skip it as you wish. In order to find the next object in sequence, press the NEXT key, and the display will show the new CNGC object. If you do not wish to view this object, press NEXT again. If you wish to return to a previously viewed object, press the PREV key until the desired catalog number is displayed and press the GO TO key. If you have set some limitations in the PARAMETERS option, it will only find those objects within your chosen confines.

If you find that the object is not well centered in the eyepiece after executing a GO TO (due to poor leveling, improper time input, or errors in site location), center the object; then press and hold the ENTER key until the display reads "Coordinates Matched." This feature in essence synchronizes the LX200 for an area of the sky, so that the next object (if the leveling, time input, or site location information is not corrected) will be better centered, provided it is not too far away from the object that you matched coordinates to.

To exit the START FIND menu selection (and cease its operation) to the main menu, press MODE.

3. **FIELD:** Press the ENTER key to identify objects in the field of view of the telescope. The LX200 will display the object centered in the eyepiece field, and how many other NGC objects are in the field at the same time (defined by the RADIUS parameter setting) as shown in Display 28:

Display 28

Objects: 5
Center: CNGC 4438

Press the ENTER button to reveal information about the object as shown in Display 29:

Display 29

CNGC 4438 VG GAL
MAG 10.1 SZ 9.3'

Display 29 is interpreted; **COMPUTERIZED NEW GENERAL CATALOG** Object #**4438**, **VERY GOOD**, **GALAXY**, **MAGNITUDE 10.1**, **SIZE 9.3'** (in arc minutes). Press ENTER again to read the coordinate location of the object (notice the * legend next to RA coordinate number, it indicates the catalog coordinates of the object, not necessarily where the telescope is pointing) as shown in Display 30:

Display 30

RA = 12:27.2*
DEC = +13'03

Press ENTER once more to see physically how far your telescope will have to move to acquire the object entered. The display will show LED bars, each bar represents ten degrees of movement as shown in Display 31:

Display 31



If you are centered on the object already, such as if you are in the FIELD menu selection, or if you have already made a GO TO command in one of the other methods for finding an object, the above display will be blank.

To review any of the data of an object, continue to press ENTER until the desired field appears. You can use these commands at any time that you have an object entered in the keypad, while directly entering in specific objects by pressing the M, STAR, or CNGC keys, in the START FIND

menu selection, the OBJECT INFORMATION menu selection, or the FIELD menu selection.

4. **PARAMETERS:** It is here that you can edit the Press ENTER to find eight options which can be reviewed by scrolling through this menu selection using the PREV or NEXT key. To edit an option, move the arrow to the desired option and press and hold ENTER until a double beep is heard and a blinking cursor appears (except in the BETTER option) Where numerical values are to be input, simply type them in from the keypad. If you make a mistake, you can move the cursor backward using the W key, then re-enter the data. To exit to the main option menu, press the ENTER key once again. A description of the eight options and how to set them is below:

- a. **TYPE GPDCO:** This menu file option allows you to select the type of CNGC objects that you wish to locate. GPDCO represent:

OBJECT SYMBOL LEGEND	
SYMBOL	DESCRIPTION
G	GALAXIES
P	PLANETARY NEBULAE
D	DIFFUSE NEBULAE
C	GLOBULAR STAR CLUSTERS
O	OPEN STAR CLUSTERS

Initially, the blinking cursor appears over the G symbol. If you decide not to look for galaxies, press NEXT and the symbol will change from an upper case letter (G) to a lower case letter (g), to deselect the GALAXIES category. If you wish to leave GALAXIES selected, then move the blinking cursor over to one of the other category symbols by pressing the W or E key on the keypad. You can then deselect the undesired categories.

If you wish to recall a category symbol, move the blinking cursor over the symbol and press the PREV key. After your selections are made, press ENTER.

- b. **BETTER:** The BETTER menu file option allows you to define the visual object quality range. At power up, the range is set at the bottom of the scale on VP, when using the START FIND menu selection, it will select all objects that are very poor through super or what could be considered an "ALL" setting. The object quality symbols are:

QUALITY SYMBOL LEGEND	
SYMBOL	DESCRIPTION
SU	SUPER
EX	EXCELLENT
VG	VERY GOOD
G	GOOD
FR	FAIR
PR	POOR
VP	VERY POOR

If you wish to define the object quality range to Very Good and better, press the ENTER key until the symbol VG is displayed. From the VP setting to VG requires three ENTER key presses. The LX200 will now select objects that look Very Good through Super.

- c. **HIGHER:** The Higher menu file option sets the horizon setting for the telescope. At power up, the setting is 00 degrees, which assumes that you have an unobstructed line-of-site to the horizon in every direction. If, however, there are things obstructing a level horizon, or if the sky quality is poor due to haze or light pollution, you can set an artificial horizon level

so that your LX200 will not try to find objects below your setting.

Enter the number of degrees above the horizon that will clear the obstructions in the sky. To roughly judge how many degrees the obstruction is taking up of the sky, merely hold your fist at arms length. Each fist diameter is approximately 5 degrees. So, if a tree is three fists high, you would make a setting of 15 degrees in the HIGHER setting. Once the setting is finalized, press ENTER.

- d. **LOWER:** The LOWER menu file option sets the zenith limit setting for the telescope. At power up, the setting is 90 degrees, which assumes that you point the telescope straight up. If, however, you have instruments on the telescope which will not clear the fork arms, or if you want to avoid the 10° Field De-Rotator limit, this setting can be used.

Enter the number of degrees from the zenith that you want to limit. Once the setting is finalized, press ENTER.

- e. **LARGER:** The LARGER menu file option allows settings of the lower apparent size limit of the objects you wish to see. At power up it is set to 000' (arc minutes). In order to make a decision as to the size limits that you may impose, it helps to have a clear understanding of exactly what an arc minute of sky is. A good example is the apparent size of the Moon, which could be expressed as 1/2 of a degree, 30 arc minutes, or 1800 arc seconds. Each arc minute is 60 arc seconds, and there are 60 arc minutes for each degree of sky.

Some beginning observers have a tough time discerning objects less than about 1 arc minute in size unless it is a double star or a planet. Astrophotographers and those involved with CCD imaging may want to set a higher value based on the desired image scale coverage that would be most impressive with different types of films or CCD cameras. Enter the new value in arc minutes, then press ENTER to exit to the option file.

- f. **SMALLER:** This menu option is the upper size object limit. At power up the setting is for 200 arc minutes or 3.33 degrees. This setting is high enough to cover the largest objects in the OBJECT LIBRARY. You may want to lower the value because of true field-of-view limitations of a particular eyepiece (see the RADIUS parameter option for calculating true field).

Other reasons for limiting the value in SMALLER is for astrophotographic or CCD imaging requirements where we don't want the object to exceed the imaging area of the film or the CCD chip.

- g. **BRIGHTER:** The lower brightness limits based on stellar magnitude can be limited in the BRIGHTER menu. At power up, the magnitude value is set to a very faint level of +20.0.

You may want to adjust the magnitude level to a brighter value starting at perhaps the limiting visual magnitude of your LX200, which is approximately 15.5 for the 16" LX200. If you are taking astrophotographs, the limiting magnitude is about 18.0. Sky conditions also greatly affect the limiting magnitude due to atmospheric haze, high clouds, light pollution, or combinations thereof.

- h. **FAINTER:** The upper level of brightness may also be adjusted with the FAINTER menu file option, although you may find few applications for limiting it to a lower value.

- i. **RADIUS:** The RADIUS value sets the boundaries of what and how many objects the LX200 recognizes is

in a given eyepiece while in the FIELD menu. At power up the RADIUS menu file option is set to 15 arc minutes, the radius of 1/2 a degree (30 arc minutes), which is about the proper setting for a 26mm eyepiece used in an 8" f/10 LX200.

To calculate the true field of an eyepiece in the telescope, first divide the focal length of the telescope (e.g., 2000mm for an 8" f/10) by the focal length of the eyepiece (the standard supplied eyepiece is a 26mm Super Plössl, 2000 divided by 26 equals 77X magnification). Then find the apparent field of the eyepiece (which is 52 degrees for the 26mm Super Plössl) and divide it by the magnification (52 divided by 77 equals 0.67 degrees, multiplied by 60 equals 40.2 arc minutes).

To get the radius of the true field of view, divide the true field by 2. In the case of the above equation, 40.2 arc minutes divided by 2 equals 20.1 arc minutes.

2. Mode Two: COORDINATES/GO TO

Mode Two allows you to see where you have pointed the LX200 in two celestial coordinate formats, either R.A. and Dec. or Altazimuth. Also in this mode you can enter new Right Ascension and Declination coordinates for any sky position, perhaps to locate objects not in the LX200 library such as comets or asteroids and have your telescope slew to the new coordinates.

a. Coordinates Menu File

You will at first see the RA = and DEC = coordinates of where the telescope is pointing. If you move the LX200 with the N, S, W, or E keys, the coordinates display will immediately update the new position in Right Ascension and Declination.

You can also display computed information of the Altazimuth coordinates (ALT = and AZ =) by pressing the ENTER key. To return to RA = and DEC =, press the ENTER key again.

The RA = display is broken down into hours, minutes, and tenths of a minute, and the DEC = display is broken down into + for North Declination and - for South Declination into degrees and minutes as shown in Display 32:

Display 32

RA = 02:45.9
DEC = +22'54

If you have made an ALTAZ style of alignment, the ALT = and AZ = coordinate display is formatted so that 0 degrees azimuth (AZ =) is due South that increases to up to 359 degrees and 59 minutes moving clockwise, or from due South moving Westerly. altitude (ALT =) is formatted so that straight overhead is +90 degrees and 00 minutes, decreasing to +00 degrees, and 00 minutes as you move the telescope level with the horizon, and then as the LX200 moves below +00.00 it will give minus altitude readings. The Altazimuth coordinate display is shown in Display 33:

Display 33

ALT = +72'50
AZ = 158'10

While in ALTAZ, you will find during slewing in one direction, that both the RA = and DEC = display will change at the same time, while the ALT = and the AZ = display will only change in the direction that the telescope is being slewed. It is also important to note that only the Declination setting circle (3, Fig. 1) will give a correct reading. The R.A. setting circle (10, Fig. 1) will only give correct readings in the POLAR setting (see APPENDIX B, page 29).

b. GO TO Menu Option

The GO TO menu option, allows you to enter new Right Ascension and Declination coordinates of any object in the sky, so that the LX200 will slew to the new position. With this ability,

your LX200 knows no bounds, any celestial object, including comets, asteroids, etc. are easily found, provided you have accurate coordinate data to refer to.

To enter a new pointing position in Right Ascension and Declination, press the GO TO key and a double beep will be heard followed by a blinking cursor that will appear over the RA = coordinate numbers. At this point, type in the new Right Ascension coordinate numbers, then press the ENTER key. You will then notice that the blinking cursor is over the DEC = coordinate numbers. Enter the new Declination coordinate numbers, then press the ENTER key and the LX200 will slew to the new coordinate position.

You can also slew to ALTAZ coordinates from the ALTAZ display as described above.

If you need to enter a minus Declination setting, move the blinking cursor over the + symbol with the W key and then press the NEXT key to get the - (minus) symbol, then move the blinking cursor to the first number with the E key and enter the new coordinate numbers. If you are already at a minus (-) Declination setting and wish to enter a plus (+) declination setting, follow the same instructions as above but press the PREV key instead to get the + symbol.

3. Mode Three: CLOCK/CALENDAR

The continuously operating clock and calendar is the life pulse of your LX200. At power up, the telescope's sidereal clock automatically allows the system computer to make orbital calculations of the planets, and correct stellar precession for superior pointing ability.

Your accurate initial input of local time and date, with its long-life lithium battery back-up, need not be re-entered every time you use the LX200, thus enhancing the user friendly aspects of the instrument.

To set the local time and date and to enter the correct GMT offset (see QUICK START, page 9). Be sure to use your local hour setting appropriately in either 12 hour or 24 hour format as predetermined by the 12/24 HOUR TELESCOPE menu file option.

The long-life lithium battery (Panasonic CR2032 3 vDC or Duracell DL2032B) is stored behind the power panel of the Drive Base (see Behind the Power Panel, page 53 for battery replacement information).

4. Mode Four: TIMER/FREQ

a. TIMER = Menu Option

The TIMER = menu option is for accurately timing different observing or imaging tasks for up to 12 hours long. Counting down to zero, in the hours, minutes, and seconds format, it will give a pleasant beeping tone to notify you that the time is up.

To set the TIMER, move the arrow to TIMER = 00:00:00. Then press and hold the ENTER key to get the double beep tone and the blinking cursor. Enter the number of hours, minutes, and seconds that you require. If you need to correct an error in entry, use the E and W keys to move the blinking cursor and then type in the correct information. After entry, press the ENTER key again and the cursor will delete. When you are ready to start your time count-down, press the ENTER key once more. To pause the count-down press ENTER again, and then again to resume.

If you want an automatic 12 hour countdown, press the ENTER key without holding. Then press ENTER to countdown.

b. FREQ = Menu File

FREQ = (Frequency) allows you to adjust the tracking speed (not slew speed) of the LX200 digitally in tenths of a hertz from 56.4 Hz to 60.1 Hz, so that you can match virtually every celestial motion in the sky. Some popular drive rate settings are:

FREQ RATE	DESCRIPTION	NOTES
60.1 Hz Q	Sidereal rate; Quartz setting	Default rate at power up. Gives sidereal frequency accuracy to $\pm 0.005\%$; Best for astrophotos
60.0 Hz	Solar and planetary rate	Average rate for tracking planets; Actual rates vary due to retrogrades, oppositions, etc.
57.9 Hz	Lunar rate	Best rate for tracking the Moon

There are three menu file options in FREQ =. To see or set the options, move the arrow to FREQ = and press ENTER. At power up, the FREQ = default is the 60.1Hz Q setting. The quartz rate is precisely fixed and cannot be altered. To choose a different rate, press the ENTER key to see 60.1 M and then again to see 60.1 M with the up and down arrow. These two menu file options can adjust the tracking speeds. The adjustment techniques are described below:

Display 34 shows the manual rate menu file option that can be adjusted by pressing and holding the ENTER key to get the double beep tone and the blinking cursor. Type in the new rate, then when finished, press the ENTER key again.

Display 34

FREQ = 60.1 M

Display 35 shows the menu file option that allows you to step the drive tracking frequency setting in tenths of a hertz, by using the PREV and NEXT (up and down arrow) keys. This is a convenient feature if you are trying to match the precise speed of a planet, comet, or any other non-stellar object. To exit this option, press the MODE key.

Display 35

FREQ = 60.1M \updownarrow

5. Mode Five: KEYPAD OFF/BRIGHTNESS ADJUST

In order to see very faint objects, it will sometimes be necessary to either dim or completely turn off the keypad red LCD backlighting. To do so press the MODE button until the display goes blank. This is the OFF option.

To set the keypad brightness, press the ENTER button and adjust the brightness to your satisfaction with the PREV and NEXT keys. To exit, press the MODE key.

This brightness setting also dims the power panel power LED and Ammeter.

NOTE: The backlighting is done by edge lighting a plastic light bar underneath the keypad. Four LEDs are used and do not give a perfectly even backlighting of the keys as keys closer to a LED will be a little brighter than those keys further away.

MAGNIFICATION AND FIELD OF VIEW

1. Magnification

The magnification (power) of the telescope depends on two characteristics: the focal length of the main telescope and the focal length of the eyepiece used during a particular observation. For example, the focal length of the LX200 7" f/15 telescope is fixed at 2670mm; the focal length of the 8" f/10 telescope is fixed at 2000mm; the focal length of the 10" f/10 telescope is fixed at 2500mm; and the focal length of the 12" f/10 telescope is fixed at 3048mm. To calculate the power in use with a particular eyepiece, divide the focal length of the eyepiece into the focal length of the main telescope.

Example: The power obtained with the 8" LX200 with the SP 26mm eyepiece is:

$$\text{Power} = \frac{2000\text{mm}}{26\text{mm}} = 77X$$

The type of eyepiece (whether MA "Modified Achromatic," PL "Plössl," SP "Super Plössl," etc.) has no bearing on magnifying power but does affect such optical characteristics as field of view, flatness of field and color correction.

The maximum practical magnification is determined by the nature of the object being observed and, most importantly, by the prevailing atmospheric conditions. Under very steady atmospheric "seeing," the 7" LX200 may be used at powers up to about 450X on astronomical objects, the 8" LX200 may be used at powers up to about 500X, the 10" LX200 up to about 600X, and the 12" LX200 up to about 750X. Generally, however, lower powers of perhaps 250X to 350X will be the maximum permissible, consistent with high image resolution. When unsteady air conditions prevail (as witnessed by rapid "twinkling" of the stars), extremely high-power eyepieces result in "empty magnification," where the object detail observed is actually diminished by the excessive power.

When beginning observations on a particular object, start with a low power eyepiece; get the object well-centered in the field of view and sharply focused; then try the next step up in magnification. If the image starts to become fuzzy as you work into higher magnifications, then back down to a lower power — the atmospheric steadiness is not sufficient to support high powers at the time you are observing. Keep in mind that a

bright, clearly resolved but smaller image will show far more detail than a dimmer, poorly resolved larger image.

Because of certain characteristics of the human eye (in particular, eye pupil diameter) and because of optical considerations inherent in the design of a telescope, there exists minimum practical powers. Generally speaking, the lowest usable power is approximately 4X per inch of telescope aperture, or about 28X in the case of the 7" telescope. During the daytime, when human eye pupil diameter is reduced, the minimum practical power with the 8" LX200 is increased to about 60X, to about 75X with the 10" LX200, and to about 90X with the 12" LX200; powers lower than this level should be avoided during daytime observations. A reasonable magnification range for daytime terrestrial observations through the 7" LX200 is from about 70X to 180X, 8" LX200 is from about 80X to 190X, through the 10" LX200 from about 100X to 200X, and the 12" LX200 from 120X to 240X. It should be noted, however, that the higher magnifications may not be used due to atmospheric distortion caused by heat, moisture, and particulate matter suspended in the air.

Accessories are available both to increase and decrease the operating eyepiece power of the telescope. See your Meade dealer and the latest Meade Catalog for information on accessories.

2. Apparent Field and Actual Field

Two terms that are often confused and misunderstood are "Apparent Field" and "Actual Field." "Apparent Field" is a function of the eyepiece design and is built into the eyepiece. While not totally accurate (but a very good approximation), "Apparent Field" is usually thought of as the angle your eye sees when looking through an eyepiece. "Actual Field" is the amount of the sky that you actually see and is a function of the eyepiece being used and the telescope.

The "Actual Field" of a telescope with a given eyepiece is calculated by dividing the "Apparent Field" of the eyepiece by the power obtained using that eyepiece.

The table below lists the most common eyepieces available and the "Apparent Field" for each. The power and "Actual Field" of view that each eyepiece yields is listed for each basic telescope optical design.

	7" f/15	8" f/6.3	10" f/6.3	8" f/10	10" f/10	12" f/10
Eyepiece/Apparent Field	Power/Actual Field	Power/Actual Field	Power/Actual Field	Power/Actual Field	Power/Actual Field	Power/Actual Field
Super Plössl Eyepieces (5-elements; 1.25" O.D., except as noted)						
6.4mm/52°	417/0.12°	200/0.26°	250/0.21°	313/0.17°	391/0.13°	476/0.11°
9.7mm/52°	275/0.19°	132/0.39°	165/0.32°	206/0.25°	258/0.20°	314/0.17°
12.4mm/52°	215/0.24°	103/0.50°	129/0.40°	161/0.32°	202/0.26°	246/0.21°
15mm/52°	178/0.29°	85/0.61°	107/0.49°	133/0.39°	167/0.31°	203/0.26°
20mm/52°	134/0.39°	64/0.81°	80/0.65°	100/0.52°	125/0.42°	152/0.34°
26mm/52°	103/0.50°	49/1.06°	62/0.84°	77/0.68°	96/0.54°	117/0.44°
32mm/52°	83/0.63°	40/1.30°	50/1.04°	63/0.83°	78/0.67°	95/0.55°
40mm/44°	67/0.66°	32/1.69°	40/1.35°	50/0.88°	63/0.70°	76/0.53°
56mm/52° (2" O.D.)	48/1.08°	23/2.27°	29/1.82°	36/1.46°	45/1.16°	54/1.04°
Super Wide Angle Eyepieces (6-elements; 1.25" O.D., except as noted)						
13.8mm/67°	193/0.35°	93/0.72°	116/0.58°	145/0.46°	181/0.37°	221/0.30°
18mm/67°	148/0.45°	71/0.94°	89/0.75°	111/0.60°	139/0.48°	169/0.40°
24.5mm/67°	109/0.61°	52/1.28°	65/1.03°	82/0.82°	102/0.66°	124/0.54°
32mm/67° (2" O.D.)	83/0.81°	40/1.67°	50/1.34°	63/1.07°	78/0.86°	95/0.71°
40mm/67° (2" O.D.)	67/1.00°	32/2.09°	40/1.67°	50/1.34°	63/1.07°	76/0.88°
Ultra Wide Angle Eyepieces (8-elements; 1.25" O.D., except as noted)						
4.7mm/84°	568/0.15°	272/0.31°	340/0.25°	426/0.20°	532/0.16°	649/0.13°
6.7mm/84°	399/0.21°	191/0.44°	239/0.35°	299/0.28°	373/0.23°	455/0.18°
8.8mm/84° (1.25" - 2" O.D.)	303/0.28°	145/0.58°	182/0.46°	227/0.37°	284/0.30°	346/0.24°
14mm/84° (1.25" - 2" O.D.)	199/0.44°	91/0.92°	114/0.73°	143/0.59°	179/0.47°	218/0.39°

APPENDIX A: EQUATORIAL WEDGE

There are two equatorial wedges used on Meade LX200 telescopes. Please read the section, below, that applies to your telescope.

1. 8" Equatorial Wedge (For 7" and 8" LX200)

The equatorial wedge permits use of the 8" LX200 telescope in an astronomical, or "equatorial," mode. The wedge fits onto the field tripod, described below, and accepts the base of the 7" or 8" LX200 fork mount (Fig. 8).

NOTE: The Meade equatorial wedge is designed solely for use in conjunction with the Meade field tripod. The wedge should never be used without the field tripod (e.g., by placing the wedge alone on a table top and then mounting the telescope on the wedge). The 7" or 8" LX200, placed onto the equatorial wedge alone without the field tripod attached to the wedge may become seriously imbalanced, to the point where the telescope may actually tip over.

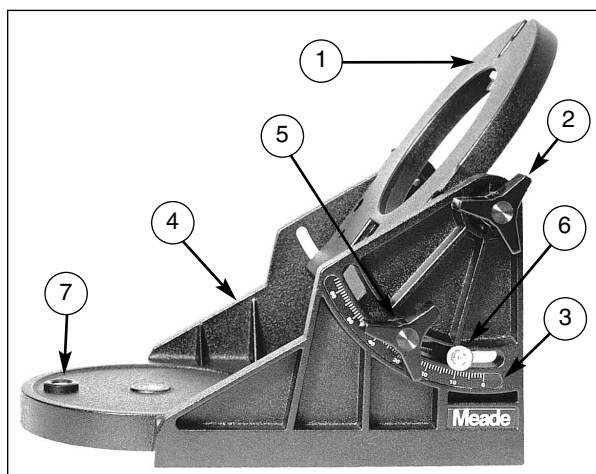


Fig. 8: Equatorial Wedge for 7" and 8" LX200 Telescope. (1) Tilt Plate; (2) Attachment Knob; (3) Latitude Scale; (4) Wedge Body; (5) Tilt Angle Adjustment Knob; (6) Fine Latitude Adjustment Mechanism; (7) Bubble Level.

The equatorial wedge for the 7" and 8" LX200 telescope is of modern design, with several important features incorporated to simplify and facilitate telescope operation. After using the wedge, you will find that the functional design features included are of very significant value in routine telescope operations. Features included are:

- Attachment of the wedge to the field tripod by means of only one manual knob.
- Quick azimuth adjustment by loosening the manual knob as described above.
- Bubble level for rapid tripod/wedge leveling.
- Etched latitude scale for fast adjustment of the latitude angle.

To assemble the equatorial wedge, follow this procedure (note that all required wedge hardware and manual knobs are shipped within the wedge carton):

- a. The wedge consists of two basic parts: the tilt plate and wedge body (1 and 4, Fig. 8). Attach the tilt-plate to the wedge body by threading in the four knobs provided. Two knobs, with washers, should be used on each side of the wedge body so that a total of 4 knobs attach the tilt plate to the wedge body.
- b. Place the wedge onto the field tripod with the central threaded rod of the tripod fitting through the center hole in the floor of the wedge. Thread the 2-1/2" diameter manual knob onto the threaded rod of the tripod and firmly tighten the manual knob.

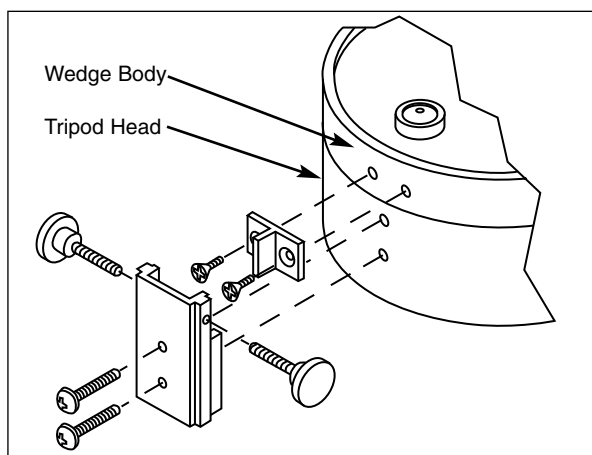


Fig. 9: Azimuth Control.

a. Azimuth Control

The azimuth control (Fig. 9) for the Meade equatorial wedge and field tripod is shipped in a plastic bag and includes the following parts:

- Azimuth base (large U shaped piece of aluminum)
- Azimuth arm (small T shaped piece of aluminum)
- 2 - Azimuth knobs
- 2 - 8-32 x 1/2" flat-head machine screws
- 2 - 8-32 x 1" round-head machine screws

To attach the azimuth control to your wedge and tripod, follow these steps:

1. Remove the 4 set screws from the wedge and field tripod (which plug the attachment holes) using a screwdriver.
2. Attach the azimuth arm to the equatorial wedge using the 2 ea. 8-32 x 1/2" flat-head machine screws.
3. Attach the azimuth base to the field tripod using the 2 ea. 8-32 x 1" round-head machine screws.
4. Thread the two azimuth adjustment knobs into the azimuth base, until they just touch the azimuth arm.

The azimuth control is now ready to use. To adjust in azimuth, loosen the 3" central wedge knob. Rotate the wedge by using the two azimuth knobs in a push-pull manner. After positioning the wedge, tighten the central wedge knob.

b. Deluxe Latitude Adjuster

The deluxe latitude adjuster (DLA) attaches directly to the equatorial wedge and permits very precise adjustments in latitude angle by the simple turning of one knob.

The equatorial wedge for Meade 7" or 8" Schmidt-Cassegrain telescope is shipped with the main crossbar of the DLA already installed. Loosen the two socket-head screws that lock the main crossbar in place, to allow the crossbar to rotate slightly if needed. Thread the long adjustment knob (3, Fig. 14) into the main crossbar and position the end of the adjustment knob into the cavity on the underside of the equatorial wedge tilt-plate. Tighten the two socket-head screws locking the main crossbar into place.

The DLA is now ready to use. To make fine latitude adjustments, follow this procedure:

1. Slightly loosen the knobs (5, Fig. 8), on each side of the wedge.
2. Turn the DLA's adjustment knob (pressing against the bottom of the tilt-plate), so that the tilt-plate moves in latitude angle.
3. Re-tighten the two knobs, which were loosened in step 1, above.

NOTE: When installing the tilt-plate to the wedge, note that it is a tight fit and the sides must generally spread slightly to accept

the tilt-plate. If the main crossbar of the DLA is already tightened into place this will inhibit your installation of the tilt-plate. You will therefore see that by releasing the screws on the ends of the DLA crossbar your installation of the wedge tilt-plate will be facilitated.

2. SUPERWEDGE (For 10" and 12" LX200)

The Superwedge permits use of the 10" and 12" LX200 telescope in an astronomical, or "equatorial," mode. The wedge fits onto the field tripod, described below, and accepts the base of the 10" and 12" LX200 fork mount (Fig. 10).

NOTE: The Meade Superwedge is designed solely for use in conjunction with the Meade field tripod. The Superwedge should never be used without the field tripod (e.g., by placing the Superwedge alone on a table top and then mounting the telescope on the wedge). The 10" and 12" LX200, placed onto the Superwedge alone without the field tripod attached to the wedge may become seriously imbalanced, to the point where the telescope may actually tip over.

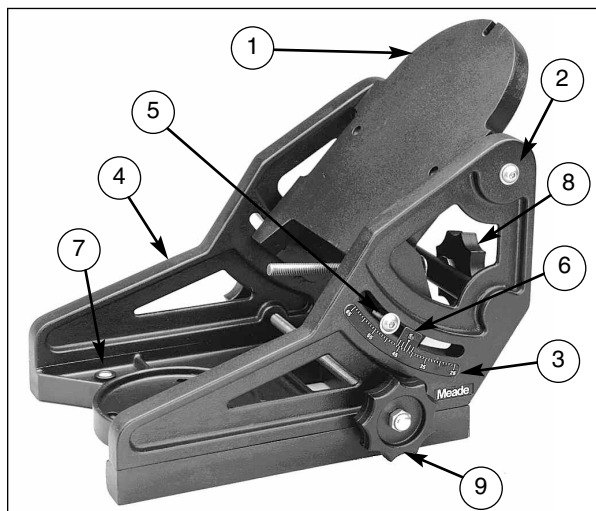


Fig. 10: Superwedge for 10" LX200 Telescope. (1) Tilt Plate; (2) Attachment Screw; (3) Latitude Scale; (4) Wedge Body; (5) Tilt Angle Adjustment Screw; (6) Vernier Pointer; (7) Bubble Level; (8) Fine Latitude Control Knob; (9) Azimuth Control Knob.

The Superwedge for the 10" and 12" LX200 telescope is of modern design, with several important features incorporated to simplify and facilitate telescope operation. After using the Superwedge for your telescope, you will find that the functional design features included are of very significant value in routine telescope operations. Some of these features include:

- Attachment of the Superwedge to the field tripod by means of only one manual knob. (For photographic applications with the telescope where extreme steadiness is required, 3 additional hex-head screws are provided).
- Quick azimuth adjustment by loosening the manual knob as described above.
- Bubble level for rapid tripod/wedge leveling.
- Etched latitude scale for fast adjustment of the latitude angle.
- Built-in latitude adjustment control.

To assemble the Superwedge, follow this procedure (note that all required wedge hardware and manual knobs are shipped within the wedge carton):

- Locate the two 8-32 nylon set screws on the rim of the tripod head and remove them. Attach the tangent arm to the tripod using the supplied 8-32 X 1/2" socket cap screws. (See Fig. 11a., below.)
- Push the field tripod threaded rod up so that the threaded rod extends above the top of the tripod head.

- Holding the threaded rod in position, place the Superwedge on top of the tripod head so that the threaded stud extending from the tripod head passes through the center hole on the wedge floor. Make sure the pin extending from the bottom of the azimuth thrust bar is positioned in the slot on the tangent arm (see Fig. 11a., above).
- Install the large hand knob/compass onto the threaded stud. Pass the three 5/16-18 X 1-1/4" button head screws through the clearance slots on the wedge floor and thread them into the tripod head.
- The lower tilt plate locking screws (3, Fig. 11) are installed in the factory to allow the tilt plate to be adjusted for any latitude greater than 25 degrees and less than 55 degrees. If viewing in a region with a latitude greater than 55 degrees, move the locking bolts to the lower mounting holes (4, Fig. 11).

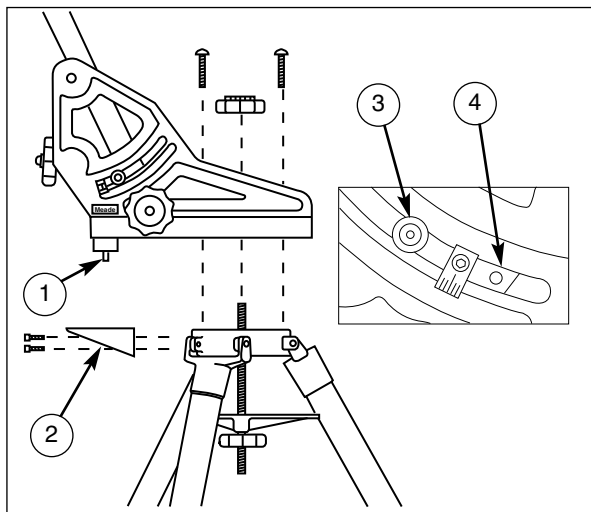


Fig. 11: Mounting Superwedge. (1) Azimuth Thrust Bar Pin; (2) Tangent Arm; (3) Lower Tilt Plate Locking Screws; (4) Lower Mounting Holes.

3. Mounting the Telescope On the Wedge

With 7" or 8" LX200 telescopes, three knobs are supplied for mounting the telescope's drive base to the tilt-plate of the equatorial wedge. With the 10" and 12" LX200, three socket screws are provided for this purpose.

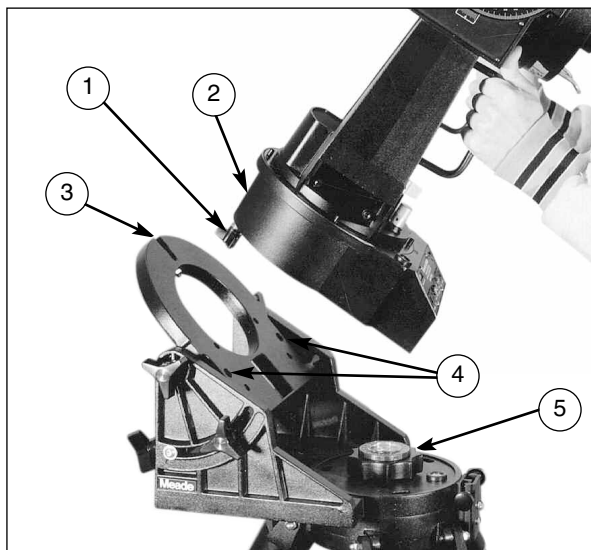


Fig. 12: Mounting to the Equatorial Wedge. (1) Drive Base Attachment Knob; (2) Telescope Drive Base; (3) Slot for Attachment Knob; (4) Additional Attachment Knob Holes; (5) Attachment Knob/Compass.

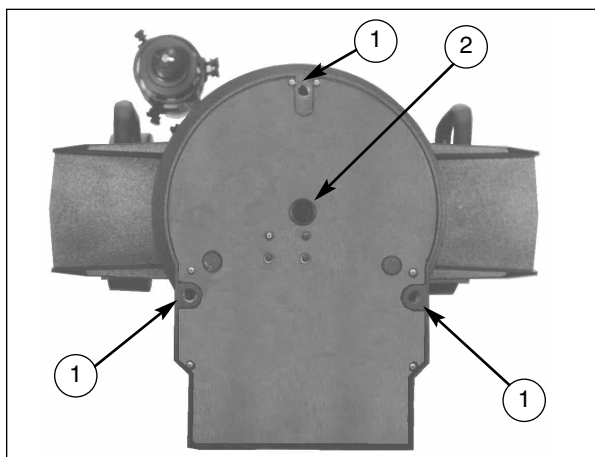


Fig. 13: Underside of Drive Base. (1) Wedge Attachment Holes; (2) Azimuth Attachment Hole (1/2-13 thread).

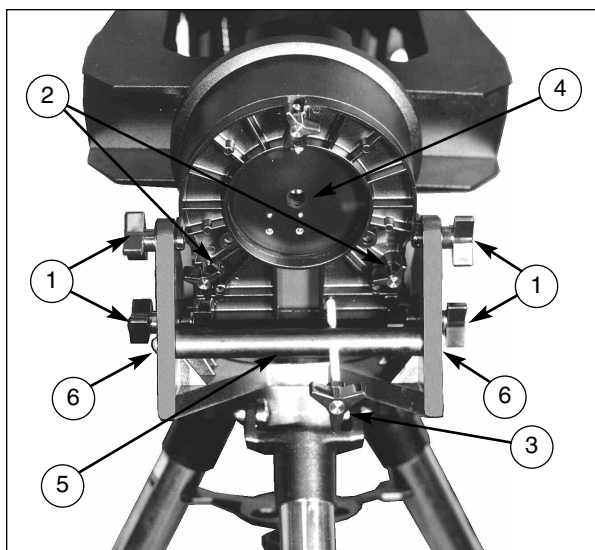


Fig. 14: Telescope on Wedge. (1) Tilt Plate Attachment Knobs; (2) Telescope to Tilt Plate Attachment Knobs; (3) Deluxe Latitude Control (DLC) Knob; (4) Altazimuth Attachment Hole; (5) DLC Main Crossbar; (6) DLC Crossbar Attachment Screws.

Thread one of these knobs (or screws, as appropriate) partially into the hole on the underside of the drive base, located at the curved-end of the drive base (4, Fig. 12). This knob or screw should be threaded in about 3 full turns, not fully threaded into the hole.

Check that the knobs or bolts at the side of the wedge (5, Fig. 8 or 5, Fig. 10), are firmly tightened before placing the telescope onto the wedge.

Grasping the 2 fork arms of the telescope firmly, with the power panel towards you, place the telescope onto the tilt plate of the wedge by sliding the knob (7" and 8" LX200) or screw (10" and 12" LX200) into the slot at the top of the curved-end of the wedge tilt-plate.

Insert the 2 remaining knobs for the 7" and 8" LX200, or socket screws for the 10" and 12" LX200, through the underside of the tilt plate and into the underside of the drive base. Tighten down all 3 knobs or screws to a firm feel. Extreme force is not necessary in this regard.

The telescope is now fully mounted onto the wedge and field tripod. Adjustments in wedge latitude angle and/or azimuth orientation may be made with the telescope in place. Further details on telescope polar alignment see **APPENDIX B**, page 30.

4. Magnetic Compass

The magnetic compass helps the observer to set-up the telescope without actually seeing the pole star Polaris. This allows setting up before dark or in locations where the view of Polaris is obstructed. The magnetic compass has an adjustment to compensate for the local angle of Magnetic Declination. Note: Magnetic Declination is the difference between Magnetic North (which the compass shows) and true north (where the telescope should be pointed). Magnetic Declination should not be confused with the astronomical term "Declination," which, when used with "Right Ascension", describes the celestial coordinate system.

a. Setting Magnetic Declination

In order to obtain an accurate reading using the compass, you must first adjust for the Magnetic Declination for your location.

1. First, determine the Magnetic Declination in your area using the Isogonic Chart (Fig. 15)
2. Squeeze the clear central vial with thumb and index finger of the left hand.
3. With the right hand, rotate the outer dial until the orienting arrow (the black arrow painted on the inside clear surface) is lined up with the desired Magnetic Declination angle on the declination scale. Notice that East Magnetic Declination is to the right of the "North" position and West Magnetic Declination is left. As an example, Fig. 16 shows the correct setting for 16 degrees West Declination, which covers Providence, Rhode Island.

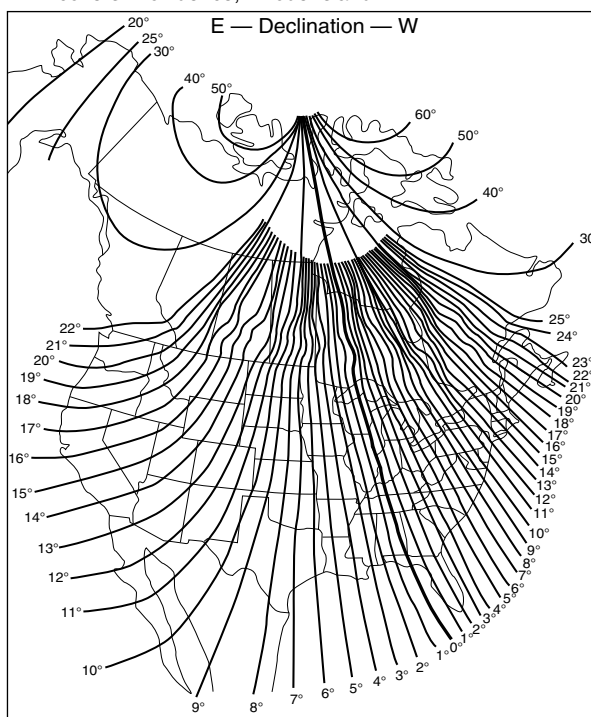


Fig. 15: Magnetic Declination Map.

b. Compass Installation

The Magnetic Compass is now set for the correct declination angle. To attach to the equatorial wedge, follow these steps:

1. Snap the Magnetic Compass into the 3" diameter wedge attachment knob (after setting the Magnetic Declination as described above). Position the compass into the knob so that the 360 degree location on the direction scale (the "North" position) lines up with one of the nine points of the knobs. (See Fig. 16.) Press the compass firmly into the knob.
2. Assemble the equatorial wedge onto the field tripod as described in the Instruction Manual using the knob/compass combination to attach the wedge to the tripod.

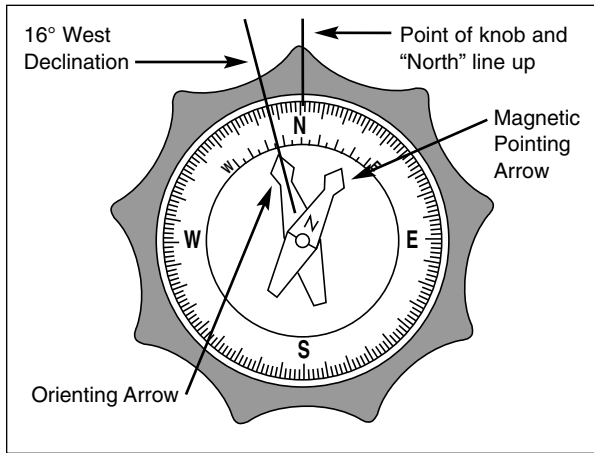


Fig. 16: Magnetic Compass.

c. Finding True North

The Magnetic Compass is now ready to use. Just follow these simple steps for a quick and easy azimuth alignment:

1. Loosen the knob/compass slightly. This allows for rotation of the equatorial wedge under the knob/compass (Fig. 17). The magnetic pointing arrow will point to magnetic north.

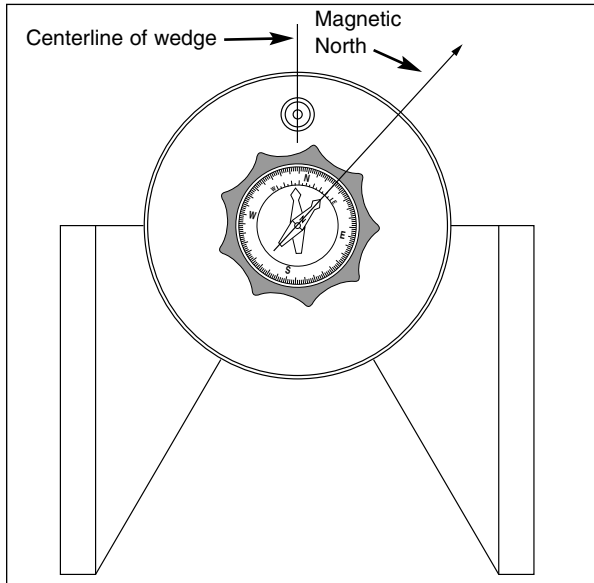


Fig. 17: Equatorial Wedge.

2. Rotate the knob/compass so that the magnetic pointing arrow lies directly over the painted black alignment arrow (painted on the bottom surface of the compass, Fig. 18). The "North" position on the direction scale (and the point on the knob/compass) now point directly north.

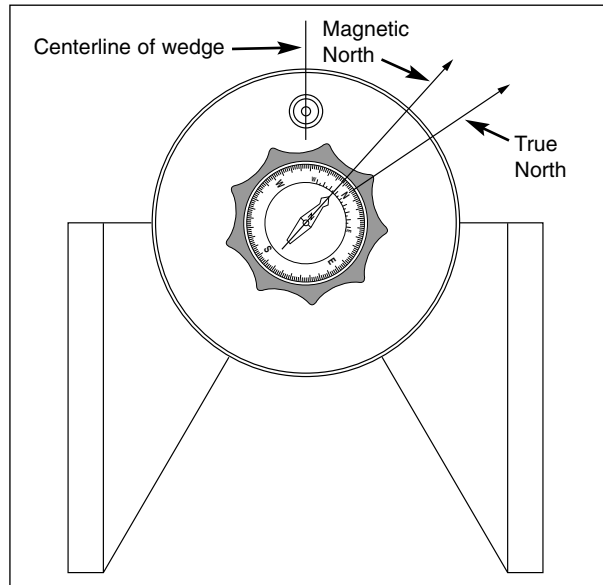


Fig. 18: Equatorial Wedge.

3. Rotate the equatorial wedge in azimuth (without moving the knob/compass) until the centerline of the wedge lines up with the point of the knob/compass (Fig. 19). The centerline of the equatorial wedge now falls directly on the true north line.

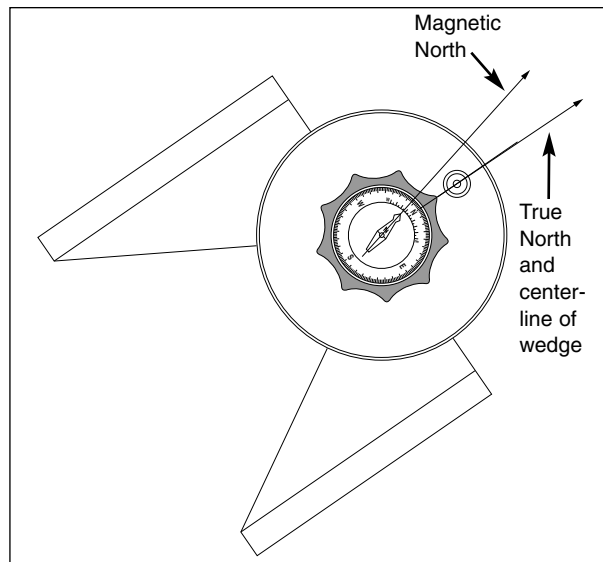


Fig. 19: Equatorial Wedge.

4. Tighten the knob/compass, locking the equatorial wedge into place.

The field tripod and equatorial wedge are now pointed directly toward celestial north, without ever having seen the North Star.

APPENDIX B: EQUATORIAL USE

1. Celestial Coordinates

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

The poles of the celestial coordinate system are defined as those two points where the Earth's rotational axis, if extended to infinity, north and south, intersect the celestial sphere. Thus, the North Celestial Pole (1, Fig. 20) is that point in the sky where an extension of the Earth's axis through the North Pole intersects the celestial sphere. This point in the sky is located near the North Star, Polaris.

In mapping the surface of the Earth, lines of longitude are drawn between the North and South Poles. Similarly, lines of latitude are drawn in an east-west direction, parallel to the Earth's Equator. The Celestial Equator (2, Fig. 20) is a projection of the Earth's Equator onto the celestial sphere.

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

R.A.: 11hr; Dec: +50°.

- **Right Ascension:** The celestial analog to Earth longitude is called "Right Ascension," or "R.A.," and is measured in time on the 24 hour "clock" and shown in hours ("hr"), minutes ("min") and seconds ("sec") from an arbitrarily defined "zero" line of Right Ascension passing through the constellation Pegasus. Right Ascension coordinates range from 0hr 0min 0sec to 23hr 59min 59sec. Thus there are 24 primary lines of R.A., located at 15 degree intervals along the celestial equator. Objects located further and further east of the prime Right Ascension grid line (0hr 0min 0sec) carry increasing R.A. coordinates.
- **Declination:** The celestial analog to Earth latitude is called Declination, or "Dec", and is measured in degrees, minutes and seconds (*e.g.*, 15° 27' 33"). Declination shown as north of the celestial equator is indicated with a "+" sign in front of the measurement (*e.g.*, the Declination of the North Celestial Pole is +90°), with Declination south of the celestial equator indicated with a "-" sign (*e.g.*, the Declination of the South Celestial Pole is -90°). Any point on the celestial equator itself (which, for example, passes through the constellations Orion, Virgo and Aquarius) is specified as having a Dec of zero, shown as 0° 0' 0".

With all celestial objects therefore capable of being specified in position by their celestial coordinates of Right Ascension and Declination, the task of finding objects (in particular, faint objects) is vastly simplified. The setting circles, R.A (10, Fig. 1) and Dec. (3, Fig. 1) of the LX200 telescope may be dialed, in

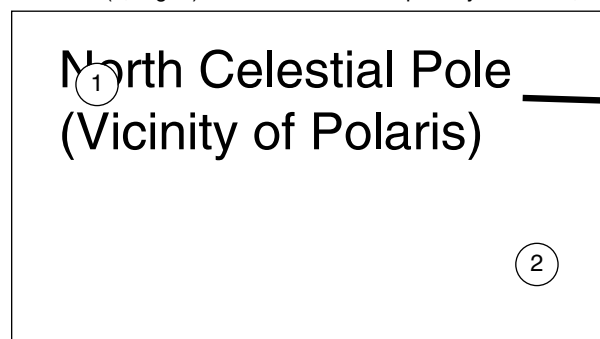


Fig. 20: The Celestial Sphere.

effect, to read the object coordinates and the object found without resorting to visual location techniques. However, these setting circles may be used to advantage only if the telescope is first properly aligned with the North Celestial Pole.

2. Lining Up with the Celestial Pole

Objects in the sky appear to revolve around the celestial pole. (Actually, celestial objects are essentially "fixed," and their apparent motion is caused by the Earth's axial rotation). During any 24 hour period, stars make one complete revolution about the pole, making concentric circles with the pole at the center. By lining up the telescope's polar axis with the North Celestial Pole (or for observers located in Earth's Southern Hemisphere with the South Celestial Pole (see **MODE FUNCTIONS**, page 16) astronomical objects may be followed, or tracked, simply by moving the telescope about one axis, the polar axis. In the case of the Meade LX200 7", 8", 10", and 12" Schmidt-Cassegrain telescopes, this tracking may be accomplished automatically with the electric motor drive.

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

Begin polar aligning the telescope as soon as you can see Polaris. Finding Polaris is simple. Most people recognize the "Big Dipper." The Big Dipper has two stars that point the way to Polaris (see Fig. 21). Once Polaris is found, it is a straightforward procedure to obtain a rough polar alignment.

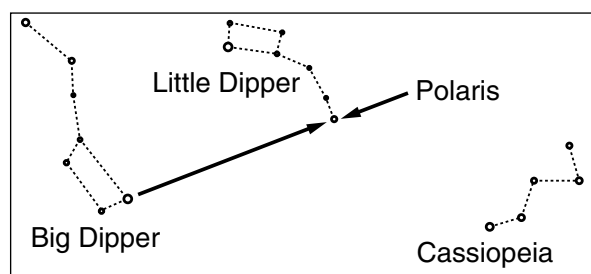


Fig. 21: Locating Polaris.

To line up the 7", 8", 10" or 12" LX200 with the Pole, follow this procedure:

- Using the bubble level located on the floor of the wedge, adjust the tripod legs so that the telescope/ wedge/tripod system reads "level."
- Set the equatorial wedge to your observing latitude as described in Appendix A.
- Loosen the Dec. lock, and rotate the telescope tube in Declination so that the telescope's Declination reads 90°. Tighten the Dec. lock. Loosen the R.A. lock, and rotate the Fork Arms to the 00 H.A. position (see **MODE FUNCTIONS**, page 16) and initiate the POLAR align sequence on the keypad.
- Using the azimuth and latitude controls on the wedge, center Polaris in the field of view. Do not use the telescope's Declination or Right Ascension controls during this process.

At this point, your polar alignment is good enough for casual observations. There are times, however, when you will need to have precise polar alignment, such as when making fine astrophotographs or when using the setting circles to find new objects.

As an aside procedure, during your first use of the telescope, you should check the calibration of the Declination setting circle (3, Fig. 1), located at the top of each side of the fork. After performing the polar alignment procedure, center the star Polaris in the telescope field. Remove the knurled central hub of the Declination setting circle and *slightly* loosen the two bolts located under the knob. Now turn the circle unit until it reads 89.2°, the Declination of Polaris, and then tighten down the two bolts and replace the knurled knob. Also realize, should you wish to use the manual setting circles, that the R.A. setting circle (10, Fig. 1) must be calibrated on the Right Ascension of a star (see **APPENDIX C**, page 31) manually every time the telescope is set up. The R.A. setting circle has two sets of numbers, the inner set is for Southern hemisphere use, while the other is for Northern hemisphere use.

Once the latitude angle of the wedge has been fixed and locked-in according to the above procedure, it is not necessary to repeat this operation each time the telescope is used, unless you move a considerable distance North or South from your original observing position. (Approximately 70 miles movement in North-South observing position is equivalent to 1° in latitude change). The wedge may be detached from the field tripod and, as long as the latitude angle setting is not altered and the field tripod is leveled, it will retain the correct latitude setting when replaced on the tripod.

3. Precise Polar Alignment

It should be emphasized that precise alignment of the telescope's polar axis to the celestial pole for casual visual observations is not necessary. Don't allow a time-consuming effort at lining up with the pole to interfere with your basic enjoyment of the telescope. For long-exposure photography, however, the ground rules are quite different, and precise polar alignment is not only advisable, but almost essential.

Notwithstanding the precision and sophistication of the drive system supplied with the Meade LX200 telescopes, the fewer tracking corrections required during the course of a long-exposure photograph, the better. (For our purposes, "long-exposure" means any photograph of about 10 minutes duration or longer). In particular, the number of Declination corrections required is a direct function of the precision of polar alignment.

Precise polar alignment requires the use of a crosshair eyepiece. The Meade Illuminated Reticle Eyepiece is well-suited in this application, but you will want to increase the effective magnification through the use of a 2X or 3X Barlow lens. Then either follow **Refined Polar Alignment** (page 17) or follow this procedure, sometimes better known as the "Drift" method (particularly if the pole star is not visible):

- Obtain a rough polar alignment as described earlier. Place the illuminated reticle eyepiece (or eyepiece/Barlow combination) into the eyepiece holder of the telescope.
- Point the telescope, with the motor drive running, at a moderately bright star near where the meridian (the North-South line passing through your local zenith) and the celestial equator intersect. For best results, the star

should be located within ± 30 minutes in R.A. of the meridian and within $\pm 5^\circ$ of the celestial equator. (Pointing the telescope at a star that is straight up, with the Declination set to 0° , will point the telescope in the right direction.)

- Note the extent of the star's drift in Declination (disregard drift in Right Ascension):
 - If the star drifts South (or down), the telescope's polar axis is pointing too far East (Fig. 22).
 - If the star drifts North (or up), the telescope's polar axis is pointing too far West (Fig. 23).
- Move the wedge in azimuth (horizontally) to effect the appropriate change in polar alignment. Reposition the telescope's East-West polar axis orientation until there is no further North-South drift by the star. Track the star for a period of time to be certain that its Declination drift has ceased. (Please note that Figs. 22, 23, 24, and 25 show the telescope pointed in the 90 degree position, and not the 0 degree position that is required for "Drift" method alignment. This is done to illustrate the position of the pole star relative to the polar axis of the telescope.)
- Next, point the telescope at another moderately bright star near the Eastern horizon, but still near the celestial equator. For best results, the star should be about 20° or 30° above the Eastern horizon and within $\pm 5^\circ$ of the celestial equator.
- Again note the extent of the star's drift in Declination:
 - If the star drifts South, (or down) the telescope's polar axis is pointing too low (Fig. 24).
 - If the star drifts North, (or up) the telescope's polar axis is pointing too high (Fig. 25).
- Use the latitude angle fine-adjust control on the wedge to effect the appropriate change in latitude angle, based on your observations above. Again, track the star for a period of time to be certain that Declination drift has ceased.

The above procedure results in very accurate polar alignment, and minimizes the need for tracking corrections during astrophotography.

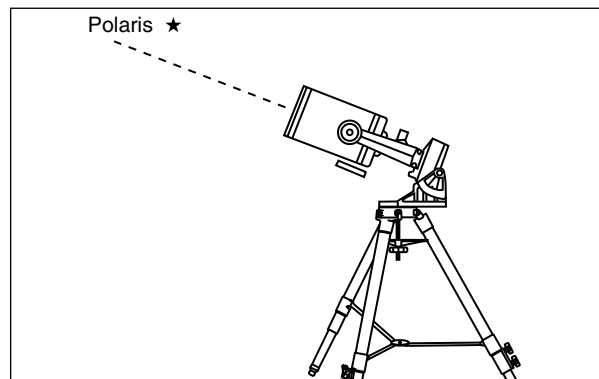


Fig. 24: Mount too low.

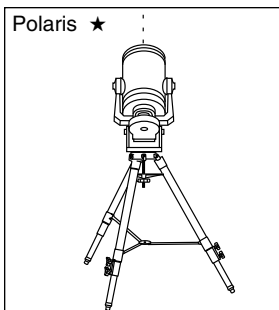


Fig. 22: Mount too far East.

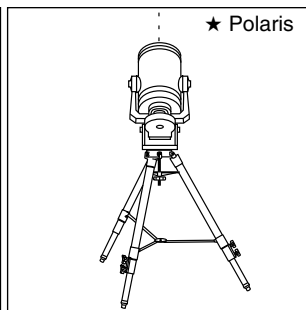


Fig. 23: Mount too far West.

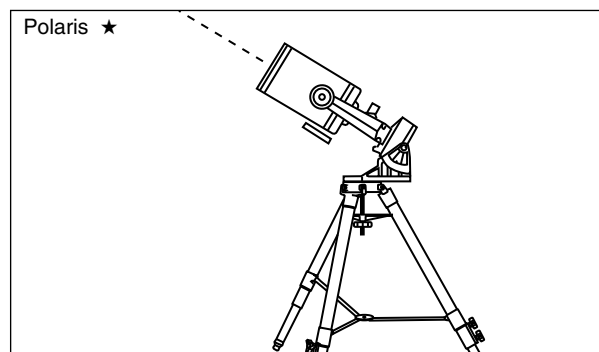


Fig. 25: Mount too high.

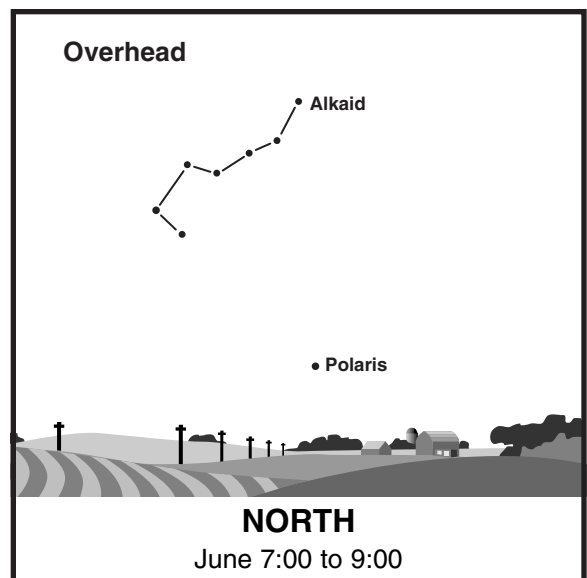
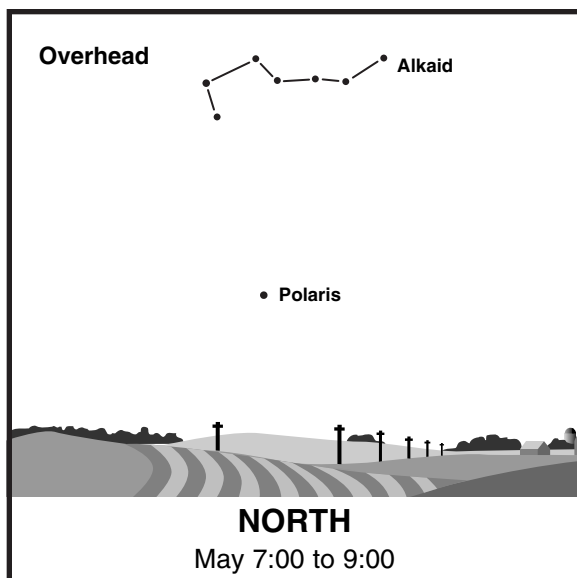
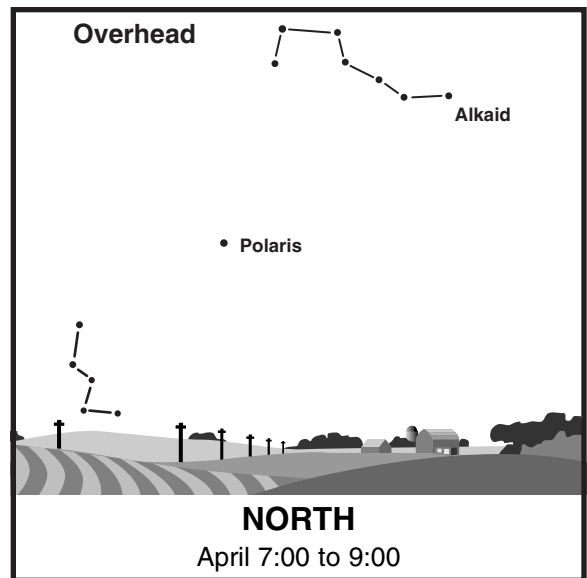
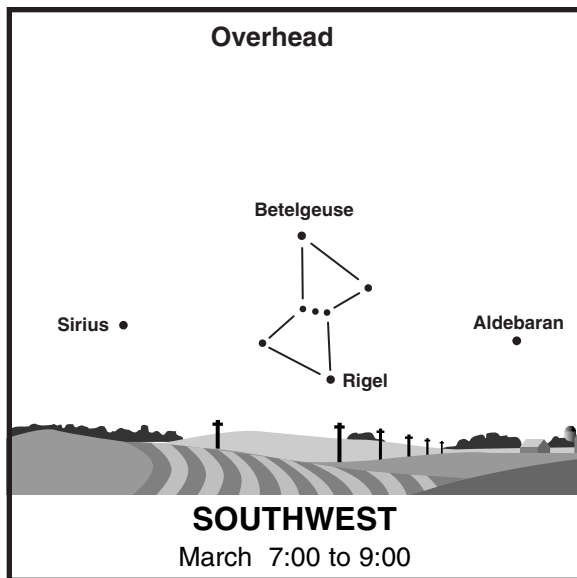
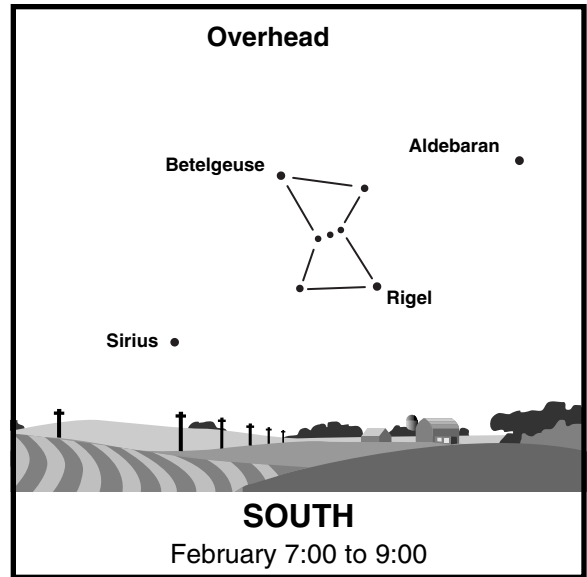
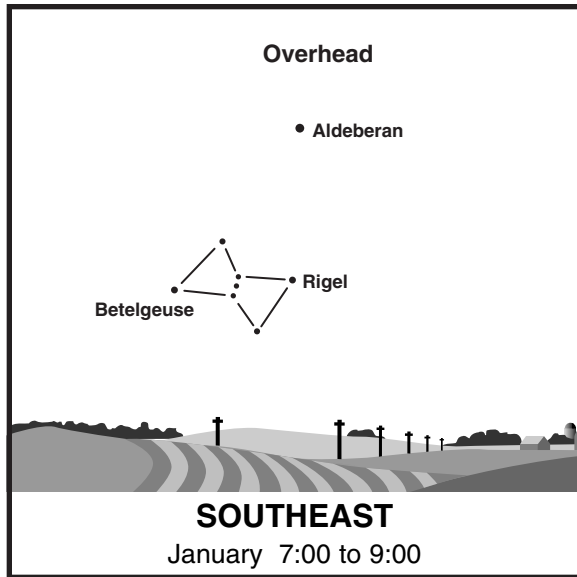
**APPENDIX C:
LX200 ALIGNMENT STAR LIBRARY
AND STAR CHARTS:**

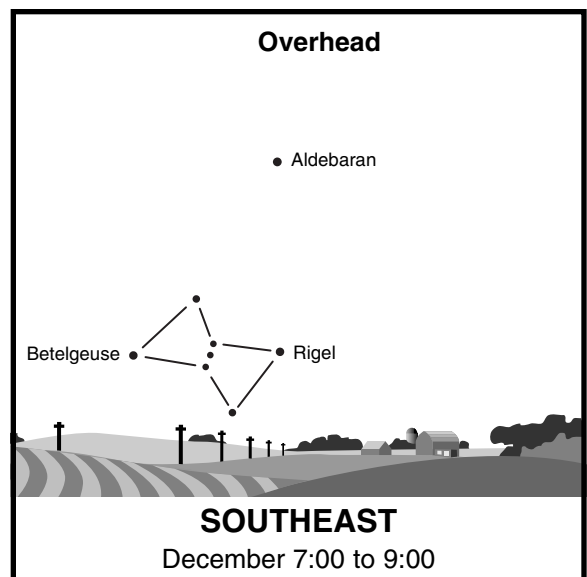
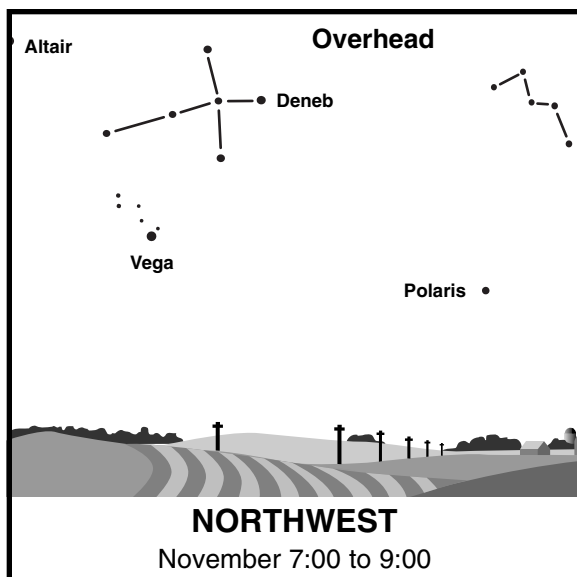
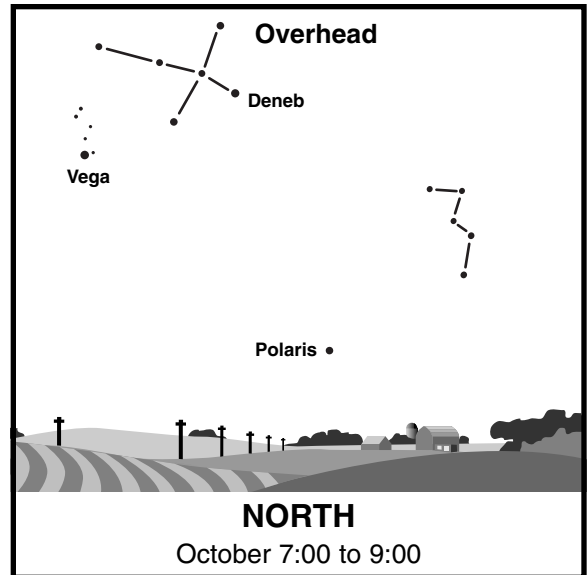
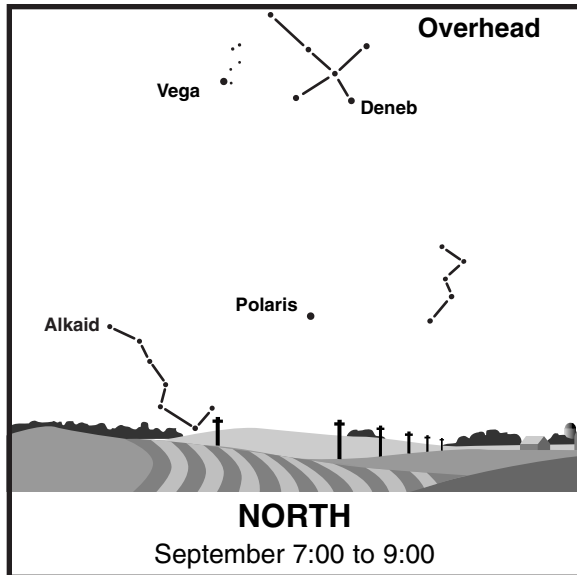
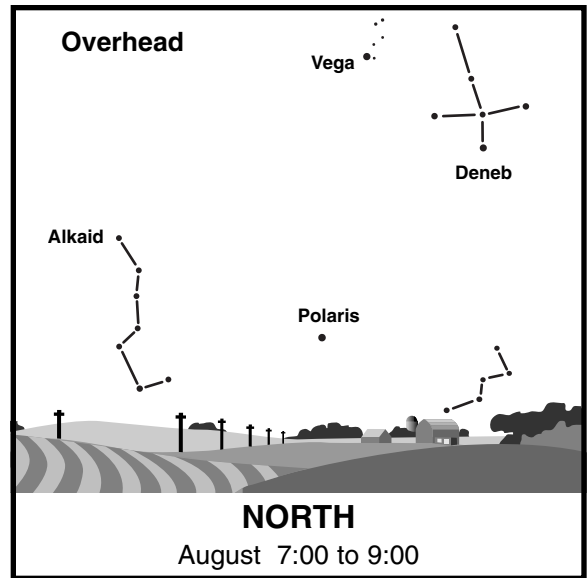
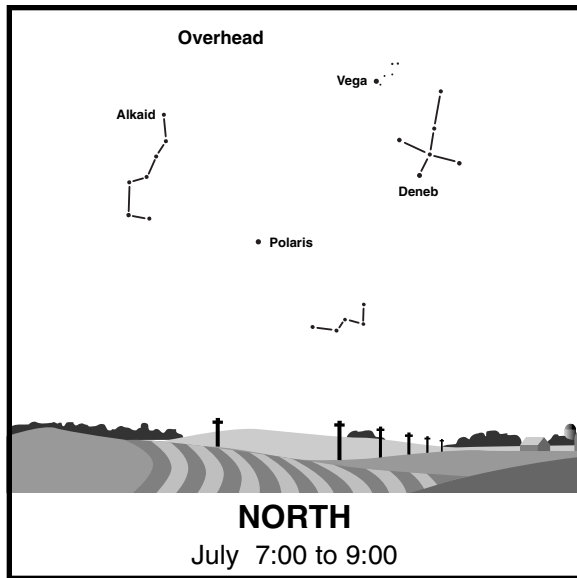
1. Alignment Stars

The LX200 utilizes 33 bright and well known stars to calibrate the telescope's Object Library in the ALTAZ and POLAR alignments. These stars were selected to allow observers from anywhere in the world on any given night, to be able to easily and quickly make precision alignments. The LX200 Alignment Star Library and Star Charts are below for your reference:

LX200 ALIGNMENT STAR LIBRARY					
STAR NAME	STAR #	MAGNITUDE	CONSTELL	R/A	DEC.
ACHERNAR	13	0.5	ERIDANUS	01 37.7	-57 14
ACRUX A	121	1.3	CRUX	12 26.6	-63 06
ALBIREO	223	3.1	CYGNUS	19 30.8	+27 58
ALKAID	140	1.9	URSA MAJOR	13 47.6	+49 19
ALDEBARAN	33	0.9	TAURUS	04 35.9	+16 31
ALNILAM	50	1.7	ORION	05 36.2	-01 12
ALPHARD	95	2.0	HYDRA	09 27.6	-08 39
ALPHEKKA	165	2.2	CORONA BOR.	15 35.5	+26 43
ALTAIR	226	0.8	AQUILA	19 50.8	+08 52
ANTARES	177	0.9	SCORPIUS	16 29.5	-26 26
ARCTURUS	147	0.0	BOOTES	14 15.7	+19 11
BETELGUESE	56	0.4	ORION	05 55.2	+07 25
BOGARDUS	58	2.6	AURIGA	05 59.8	+37 13
CANOPUS	63	-0.7	CARINA	06 24.0	-52 42
CAPELLA	42	0.1	AURIGA	05 16.6	+46 00
CASTOR A	78	1.9	GEMINI	07 34.6	+31 53
DENEK	232	1.3	CYGNUS	20 41.5	+45 17
DENEKOLA	114	2.1	LEO	11 49.1	+14 34
DIPHDA	8	2.0	CETUS	00 43.6	-17 59
ENIF	238	2.4	PEGASUS	21 44.2	+09 53
FOMALHAUT	247	1.2	PISCES AUST.	22 57.7	-29 38
HADAR	144	0.6	CENTAURUS	14 03.9	-60 24
HAMAL	17	2.0	ARIES	02 07.2	+23 28
MARKAB	249	2.5	PEGASUS	23 04.8	+15 12
MIRA	20	2.1	CETUS	02 19.4	-02 58
POLARIS	19	2.0	URSA MINOR	02 14.7	+89 17
POLLUX	81	1.1	GEMINI	07 45.4	+28 02
PROCYON	80	0.4	CANIS MINOR	07 39.3	+05 14
REGULUS	100	1.4	LEO	10 08.5	+11 58
RIGEL	41	0.1	ORION	05 14.6	-08 12
SIRIUS	67	-1.5	CANIS MAJOR	06 45.2	-16 43
SPICA	138	1.0	VIRGO	13 25.2	-11 10
VEGA	214	0.0	LYRA	18 37.0	+38 47

2. Star Charts (for Northern Hemisphere Observers)





APPENDIX D: LX200 64,359-OBJECT LIBRARY

1. The LX200 64,359-Object Library

The LX200 64,359-Object Library is a collection of the most studied and fantastic objects in the sky. It includes:

- 15,928 SAO (Smithsonian Astrophysical Observatory) Catalog of Stars: All stars brighter than 7th magnitude.
- 12,921 UGC (Uppsala General Catalog) Galaxies: Complete catalog.
- 7,840 NGC (New General Catalog) objects: Complete Catalog.
- 5,386 IC (Index Catalog) objects: Complete catalog.
- 21,815 GCVS (General Catalog of Variable Stars) objects: Complete catalog.
- 351 Alignment Stars: LX200 alignment stars.
- 110 M (Messier) objects: Complete catalog.
- 8 major planets from Mercury to Pluto.

This appendix has three object listings in sections 2, 3, and 4. Section 2 (page 36) is a partial list of 278 of the best NGC objects. These are most of the best objects in the sky, and as such, make good first targets. Section 3 (page 43) is a list of the 250 brightest stars and 100 double stars. The complete Messier list is shown in Section 4 (page 49).

The above databases are accessed through the M, STAR, and CNGC keys. The M key accesses the M object database only; the STAR key the SAO, STAR, GCVS, and planet databases; and the CNGC key the UGC, NGC, and IC databases.

When the STAR or CNGC key is pressed, the display will show which database is currently active. At this point you can enter the object number for that database, or hit ENTER to bring up the menu to change databases. The LX200 will remember which database was last used.

a. SAO Catalog

The standard Star catalog used in astronomy, this catalog includes all stars brighter than 7th magnitude.

b. UGC Catalog

This catalog of galaxies includes objects as faint as 15th magnitude.

c. CNGC Catalog

The CNGC is enhanced from the RNGC in many ways. Angular sizes are given in arc-seconds on the CNGC listing, and in a convenient scaled format on the LX200 display. Magnitudes are given to 0.1 magnitude where possible.

The coordinates in the CNGC listing are listed for the year 2000. The LX200 calculates object positions upon power up to the current date (as shown on the time/date display). This makes the LX200 pointing more accurate.

Objects have been assigned a "Visual Quality Rating" (VQ). A large number of VQs have been obtained by observing the objects. To make the VQs as useful as possible, all observations have been made with the same telescope and eyepiece under substantially identical observing conditions. Only for very small objects was a higher power eyepiece used. Your "Visual Quality Rating" of a particular object will vary, largely due to sky conditions.

If the object has been rated by observation, an upper-case character (ABCDEFGF) is used for the VQ on the CNGC listing. If the object has not been observed, the VQ has been estimated by a computer program from the object type, size, and brightness and the VQ is specified in lower-case characters (abcdefg). The VQs for visually-rated objects are a considerably more consistent guide to observability and appearance than either the computed VQs or an examination of the type, magnitude, and size data.

The following guide to VQs was used in the visual observation process:

SUPER	Very bright object with very interesting shape or structure.
EXCEL	Bright object with very interesting shape or structure. OR Very bright object with moderately interesting shape or structure.
V GOOD	Bright object with moderately interesting shape or structure. OR Very bright object with little or no interesting shape or structure.
GOOD	Easy to see without averted vision with some interesting shape or structure. OR Bright object, but little or no interesting shape or structure.
FAIR	Easy to see without averted vision, but little or no interesting shape or structure.
POOR	Easy to see with averted vision. Often borderline visible without averted vision.
V POOR	A struggle to see with careful use of averted vision.
(none)	Not yet rated AND missing information for computer estimate. OR Could not see despite careful use of averted vision.

All, or very nearly all, of the objects in the CNGC are visible with standard instrumentation and observing conditions used to obtain the visual quality ratings. It is a good indication of what to expect with similar equipment by experienced deep-sky observers in excellent conditions. Naturally smaller telescopes and/or less optimal observing conditions will lower the apparent quality of all objects.

The following is a description of the format of the optional **CNGC** listing for each object:

COLUMN	NAME	DESCRIPTION
1	CNGC #	CNGC 0001 - CNGC 7840
2	RA	Right Ascension
3	DEC	Declination
4	SIZE	Size of object (arc-seconds)
5	MAG	Magnitude (-5.5 through 19.9)
6	TYPE	Type of object
7	*	* object is not in the RNGC
8	ALT CAT	Alternate catalog name & number
9	VQ	Visual Quality Rating (abcdefg) or (ABCDEFGF)
10	TAGS	Object Type # (0-F): S = Sky-Cat : T = Tirion
11	COMMENTS	Name, comments, other info

The following types are distinguished in the **CNGC**:

TYPE	LEGEND	DESCRIPTION
0	None	Unverified Southern Object
1	OPEN	Open Cluster
2	GLOB	Globular Cluster
3	DNEB	Diffuse Nebula
4	PNEB	Planetary Nebula (or SN Remnant)
5	GAL	Galaxy
6	OPEN + DNEB	Open Cluster + Diffuse Nebula
7	None	Non-Existent Object
8	STAR	Star
9	MULTI+STAR	Multiple Star
A	MULTI+GAL	Multiple Galaxy (Usually Interacting)
B	DNEB	Dark Nebula in front of Diffuse Nebula
C	GAL+OPEN	Open Cluster in External Galaxy
D	GAL+GLOB	Globular Cluster in External Galaxy
E	GAL+DNEB	Diffuse Nebula in External Galaxy
F	GAL+OPEN+DNEB	Open Cluster + Diffuse Nebula in Galaxy
S		Object is also listed in the <i>Sky Catalogue 2000</i>
T		Object is also listed in the <i>Tirion Sky Atlas 2000</i>

d. IC Catalog

This is the complete IC catalog of a variety of objects that the standard NGC catalog missed.

e. GCVS Catalog

This is a complete catalog of variable stars (shown at the bottom of this page).

Variable stars from the GCVS are entered using a six digit number. The first two digits, refer to the constellation where the variable star is located and is listed in the table below.

The next four digits are assigned sequentially within each constellation according to the standard sequence of variable-star designations (R, S, ...).

Therefore, the first star in the constellation of Virgo would be entered as: 860001.

f. Star Catalog

The STAR catalog contains the 250 brightest stars (STAR 1 through STAR 250), 100 interesting double stars (STAR 251 through STAR 350), plus Sigma Octantis, the southern pole star (STAR 351).

g. M (Messier) Catalog

The M catalog has been the benchmark deep-sky catalog for years. Recently expanded to 110 objects, the M (Messier) catalog contains most of the best deep-sky objects.

h. Planet Catalog

The LX200 calculates the orbital positions of the eight major planets for the current calendar date. To access a planet, use the STAR key and enter the appropriate number as indicated below: (*NOTE: 903 is the Moon.*)

OBJECT LIBRARY PLANET LEGEND			
PLANET	STAR #	PLANET	STAR#
MERCURY	901	SATURN	906
VENUS	902	URANUS	907
MARS	904	NEPTUNE	908
JUPITER	905	PLUTO	909

Code	Const	Code	Const	Code	Const	Code	Const
01	AND	23	CIR	45	LAC	67	PSA
02	ANT	24	COL	46	LEO	68	PUP
03	APS	25	COM	47	LMI	69	PYX
04	AQR	26	CRA	48	LEP	70	RET
05	AQL	27	CRB	49	LIB	71	SGE
06	ARA	28	CRV	50	LUP	72	SGR
07	ARI	29	CRT	51	LYN	73	SCO
08	AUR	30	CRU	52	LYR	74	SCL
09	BOO	31	CYG	53	MEN	75	SCT
10	CAE	32	DEL	54	MIC	76	SER
11	CAM	33	DOR	55	MON	77	SEX
12	CNC	34	DRA	56	MUS	78	TAU
13	CVN	35	EQU	57	NOR	79	TEL
14	CMA	36	ERI	58	OCT	80	TRI
15	CMI	37	FOR	59	OPH	81	TRA
16	CAP	38	GEM	60	ORI	82	TUC
17	CAR	39	GRU	61	PAV	83	UMA
18	CAS	40	HER	62	PEG	84	UMI
19	CEN	41	HOR	63	PER	85	VEL
20	CEP	42	HYA	64	PHE	86	VIR
21	CET	43	HYI	65	PIC	87	VOL
22	CHA	44	IND	66	PSC	88	VUL

2. CNGC Catalog

CNGC#	RA	DEC	SIZE	MAG	TYPE & DESCRIPTION	ALT NAME	Q TAGS	COMMON NAME/COMMENTS
0045	00 14.0	-23 10	486	10.4	GALAXY S- IV-V	UGC A4	c 5 ST	8.1x5.8
0055	00 15.1	-39 13	1944	8.2	GALAXY SBm: PEC EMISSION		b 5 ST	32.4x6.5
0104	00 24.1	-72 04	1854	4.0v	GLOB CLUS sp=G3	47 Tuc	B 2 ST	47 Tuc 16kly
0129	00 29.9	+60 14	1260	6.5v	OPEN CLUS		c 1 ST	
0134	00 30.4	-33 15	486	10.1	GALAXY S(B)b+		c 5 ST	8.1x2.6
0188	00 44.3	+85 21	840	8.1v	OPEN CLUS sp=F2		c 1 ST	Oldest Open Cluster 5kly
0205	00 40.4	+41 42	1044	8.0	GALAXY E6:	UGC 426	C 5 ST	M110 Comp of M31 17.4x9.8
0221	00 42.8	+40 53	456	8.2	GALAXY E2	UGC 452	C 5 ST	M32 Comp of M31 7.6x5.8
0224	00 42.8	+41 17	10680	3.5	GALAXY Sb I-II	UGC 454	B 5 ST	M31 Andromeda Gal 178x63
0225	00 43.5	+61 48	720	7.0	OPEN CLUS		c 1 ST	
0247	00 47.1	-20 44	1200	8.9	GALAXY S- IV	UGC A11	b 5 ST	20.0x7.4
0253	00 47.5	-25 17	1506	7.1	GALAXY Scp	UGC A13	C 5 ST	25.1x7.4
0288	00 52.6	-26 36	828	8.1v	GLOB CLUS		b 2 ST	
0300	00 55.0	-37 42	1200	8.7	GALAXY Sd III-IV		b 5 ST	20.0x14.8
0362	01 02.4	-70 51	774	6.6v	GLOB CLUS		b 2 ST	
0370	01 04.8	+02 07	720	9.3	GALAXY Ir+ V	* IC 1613	c 5 S	12.0x11.2
0411	01 07.9	-71 46	750	11.0	GLOB CLUS IN SMC		c D	
0458	01 14.9	-71 32	750	10.5	GLOB CLUS IN SMC		c D	
0581	01 33.3	+60 43	360	7.4v	OPEN CLUS	CNGC 0581	D 1 ST	M103
0598	01 33.9	+30 40	3720	5.7	GALAXY Sc II-III	UGC 1117	C 5 ST	M33 Triangulum Gal 62x39
0628	01 36.7	+15 47	612	9.2	GALAXY Sc I	UGC 1149	D 5 ST	M74 10.2x9.5
0650	01 42.0	+51 34	290	12.2	PLAN NEB PART OF 0651	CNGC 0650	C 4 ST	M76 Little Dumbbell Nebula
0651	01 42.0	+51 34	290	12.2	PLAN NEB PART OF 0650		C 4 ST	Little Dumbbell Nebula
0654	01 43.9	+61 53	300	6.5v	OPEN CLUS		c 1 ST	
0660	01 43.0	+13 38	546	10.8	GALAXY SBap	UGC 1201	c 5 S	9.1x4.1
0744	01 58.6	+55 29	660	7.9v	OPEN CLUS		c 1 ST	
0752	01 57.8	+37 41	3000	5.7v	OPEN CLUS sp=A5		c 1 ST	1200ly
0869	02 19.1	+57 09	1800	4.3p	OPEN CLUS sp=B1		A 1 ST	Double Cluster h Per 7kly
0884	02 22.5	+57 07	1800	4.4p	OPEN CLUS sp=B0		A 1 ST	Double Cluster x Per 8kly
0925	02 27.3	+33 35	588	10.0	GALAXY S(B)c II-III	UGC 1913	c 5 ST	9.8x6.0
0956	02 32.4	+44 38	480	8.9p	OPEN CLUS		c 1 S	
0957	02 33.6	+57 31	660	7.6v	OPEN CLUS		c 1 ST	
1023	02 40.5	+39 04	522	9.5	GALAXY E7p	UGC 2154	C 5 ST	8.7x3.3
1025	02 39.9	-34 32	1200	9.0p	GALAXY dE3	*	b 5 S	20.0x13.8
1027	02 42.7	+61 33	1200	6.7v	OPEN CLUS		c 1 ST	
1039	02 42.0	+42 47	2100	5.2v	OPEN CLUS	CNGC 1039	C 1 ST	M34
1068	02 42.7	-00 01	414	8.8	GALAXY Sbp SEYFERT	UGC 2188	D 5 ST	M77 6.9x5.9 Seyfert Galaxy
1097	02 46.5	-30 16	558	9.3	GALAXY S(B)b I-II 2-SYS	UGC A41	c A ST	9.3x6.6 2-SYS + E5
1112	02 51.2	+60 27	720	6.5v	OPEN CLUS + DNEB IV 3 p n	* IC 1848	c 6 ST	
1232	03 09.7	-20 34	468	9.9	GALAXY Sc I 2-SYS		C A ST	7.8x6.9 2-SYS +SBm
1245	03 14.6	+47 14	600	8.4v	OPEN CLUS		c 1 ST	
1261	03 12.3	-55 14	414	8.4v	GLOB CLUS		c 2 ST	
1291	03 17.3	-41 05	630	8.5	GALAXY SBa		b 5 ST	10.5x9.1
1313	03 10.0	-66 41	510	9.4	GALAXY SBd		c 5 ST	8.5x6.6
1316	03 22.6	-37 14	426	8.9	GALAXY S(B)0p 3-SYS		c A ST	7.1x5.5 3-SYS
1342	03 31.6	+37 20	840	6.7v	OPEN CLUS		c 1 ST	
1360	03 33.4	-25 51	390	9.0p	PLAN NEB		c 4 ST	
1365	03 33.7	-36 08	588	9.5	GALAXY SBb I-II		c 5 S	9.8x5.5
1432	03 46.0	+24 09	6600	3.4	OPEN CLUS + RNEB		c 6 S	Pleiades M45 Blue Nebula
1444	03 49.4	+52 39	240	6.6v	OPEN CLUS		c 1 ST	
1454	03 46.7	+68 07	1068	9.1	GALAXY S(B)c I-II	* IC 342	b 5 ST	17.8x17.4 UGC 2847
1457	03 47.1	+24 07	7200	1.6	OPEN CLUS + RNEB sp=B6	* CNGC 1457	c 6 ST	M45 Pleiades 410ly
1502	04 07.4	+62 19	480	5.7v	OPEN CLUS		c 1 ST	
1513	04 10.1	+49 31	540	8.4v	OPEN CLUS		c 1 ST	
1528	04 15.4	+51 15	1440	6.4v	OPEN CLUS		c 1 ST	
1545	04 20.9	+50 15	1080	6.2v	OPEN CLUS		c 1 ST	
1582	04 32.2	+43 52	2220	7.0p	OPEN CLUS		c 1 S	
1647	04 46.2	+19 05	2700	6.4v	OPEN CLUS		c 1 ST	
1662	04 48.5	+10 56	1200	6.4v	OPEN CLUS		c 1 S	
1664	04 51.0	+43 42	1080	7.6v	OPEN CLUS		c 1 ST	

CNGC Catalog (continued)

CNGC#	RA	DEC	SIZE	MAG	TYPE & DESCRIPTION	ALT NAME	Q TAGS	COMMON NAME/COMMENTS
1746	05 03.6	+23 49	2520	6.1p	OPEN CLUS		c 1 ST	
1763	04 56.8	-66 24	1500	8.3	OPEN CLUS + ENEB IN LMC		B F S	
1807	05 10.7	+16 32	1020	7.0v	OPEN CLUS		c 1 ST	
1817	05 12.1	+16 42	960	7.7v	OPEN CLUS		c 1 ST	
1820	05 03.8	-67 17	410	9.0	OPEN CLUS IN LMC		c C	
1851	05 14.0	-40 02	660	7.3v	GLOB CLUS sp=F7		b 2 ST	46kly X-Ray Source
1857	05 20.1	+39 21	360	7.0v	OPEN CLUS		c 1 ST	
1893	05 22.7	+33 24	660	7.5v	OPEN CLUS + ENEB HII		c 6 ST	
1904	05 24.2	-24 31	522	8.0v	GLOB CLUS	CNGC 1904	D 2 ST	M79
1912	05 28.7	+35 51	1260	6.4v	OPEN CLUS sp=B5	CNGC 1912	C 1 ST	M38 4600ly
1952	05 34.5	+22 01	360	8.4	PLAN NEB EMIS SN REM	CNGC 1952	B 4 ST	M1 Crab Nebula 4kly
1960	05 36.2	+34 08	720	6.0v	OPEN CLUS	CNGC 1960	C 1 ST	M36
1966	05 26.5	-68 47	780	8.5	OPEN CLUS + DNEB IN LMC		b F S	
1975	05 35.4	-04 41	600	8.8	DIFF RNEB		b 3 ST	Blue
1976	05 35.3	-05 23	3960	3.9	DIFF RNEB + ENEB	CNGC 1976	A 3 ST	M42 Orion Nebula Blue+Red
1980	05 35.2	-05 55	840	2.5	OPEN CLUS + ENEB sp=O5		c 6 ST	Trapezium in M42 1300ly
1981	05 35.3	-04 26	1500	4.6v	OPEN CLUS		b 1 ST	
1982	05 35.5	-05 16	1200	5.8	DIFF RNEB + ENEB	CNGC 1982	C 3 ST	M43 Orion Nebula Extension
1999	05 36.5	-06 43	960	9.5	DIFF RNEB		C 3 ST	
2024	05 42.0	-01 50	1800	8.8	DIFF ENEB HII		b 3 ST	Red Near Zeta Ori
2068	05 46.8	+00 03	480	11.3	DIFF RNEB	CNGC 2068	C 3 ST	M78 Blue 1500ly
2070	05 38.5	-69 05	300	8.3v	OPEN CLUS + ENEB IN LMC		B F ST	Tarantula Nebula Very Red
2074	05 39.0	-69 30	960	8.5	OPEN CLUS + ENEB IN LMC		b F S	30 Dor Nebula (part)
2099	05 52.4	+32 33	1440	5.6v	OPEN CLUS sp=B8	CNGC 2099	C 1 ST	M37 4200ly
2129	06 01.1	+23 18	420	6.7v	OPEN CLUS		c 1 ST	
2168	06 08.9	+24 21	1680	5.1v	OPEN CLUS sp=B5	CNGC 2168	C 1 ST	M35 2800ly
2169	06 08.4	+13 58	420	5.9v	OPEN CLUS		c 1 ST	
2175	06 09.8	+20 19	1080	6.8v	OPEN CLUS + ENEB		c 6 ST	Red Faint/Low Contrast
2194	06 13.8	+12 49	600	8.5v	OPEN CLUS		c 1 ST	
2204	06 15.7	-18 39	780	8.6v	OPEN CLUS		c 1 ST	
2215	06 20.8	-07 17	660	8.4v	OPEN CLUS		c 1 ST	
2232	06 26.8	-04 44	1800	3.9v	OPEN CLUS sp=B1		b 1 S	1600ly
2237	06 30.3	+05 03	4800	7.4	OPEN CLUS + ENEB		c 6 ST	Cluster in Rosette Nebula
2244	06 32.3	+04 52	1440	4.8v	OPEN CLUS + ENEB sp=O5		b 6 ST	Rosette Nebula 5300ly
2250	06 32.8	-05 02	480	8.9p	OPEN CLUS		c 1 S	
2251	06 34.8	+08 22	600	7.3v	OPEN CLUS		c 1 ST	
2252	06 35.0	+05 23	1200	7.7p	OPEN CLUS		c 1 S	
2264	06 41.2	+09 53	1200	3.9v	OPEN CLUS + ENEB sp=O8		b 6 ST	S Mon + Cone Nebula 2400ly
2281	06 49.4	+41 04	900	5.4v	OPEN CLUS		c 1 ST	
2286	06 47.7	-03 10	900	7.5v	OPEN CLUS		c 1 ST	
2287	06 47.1	-20 45	2280	4.5v	OPEN CLUS sp=B4	CNGC 2287	C 1 ST	M41 2200ly
2301	06 51.8	+00 28	720	6.0v	OPEN CLUS		c 1 ST	
2323	07 02.9	-08 20	960	5.9v	OPEN CLUS	CNGC 2323	D 1 ST	M50
2324	07 04.2	+01 04	480	8.4v	OPEN CLUS		c 1 ST	
2331	07 07.3	+27 21	1080	8.5p	OPEN CLUS		c 1 S	
2335	07 06.6	-10 05	720	7.2v	OPEN CLUS		c 1 ST	
2343	07 08.3	-10 40	420	6.7v	OPEN CLUS		c 1 S	
2345	07 08.4	-13 10	720	7.7v	OPEN CLUS		c 1 ST	
2353	07 14.7	-10 17	1200	7.1v	OPEN CLUS		c 1 ST	
2354	07 14.2	-25 43	1200	6.5v	OPEN CLUS		c 1 ST	
2360	07 17.7	-15 38	780	7.2v	OPEN CLUS		c 1 ST	
2362	07 18.7	-24 58	480	4.1v	OPEN CLUS + ENEB sp=O9		c 6 ST	Open Clus = 20' Very Red
2374	07 24.1	-13 15	1140	8.0v	OPEN CLUS		c 1 ST	
2395	07 27.1	+13 35	720	8.0v	OPEN CLUS		c 1 ST	
2396	07 28.2	-11 44	600	7.4p	OPEN CLUS		c 1 S	
2403	07 36.9	+65 36	1068	8.4	GALAXY Sc III	UGC 3918	b 5 ST	17.8x11.0
2420	07 38.4	+21 34	600	8.3v	OPEN CLUS		c 1 ST	
2421	07 36.3	-20 37	600	8.3v	OPEN CLUS		c 1 ST	
2422	07 36.6	-14 29	1800	4.4v	OPEN CLUS sp=B3	CNGC 2422	D 1 ST	M47 1600ly
2423	07 37.2	-13 52	1140	6.7v	OPEN CLUS		c 1 ST	

CNGC Catalog (continued)

CNGC#	RA	DEC	SIZE	MAG	TYPE & DESCRIPTION	ALT NAME	Q TAGS	COMMON NAME/COMMENTS
2437	07 41.9	-14 49	1620	6.1v	OPEN CLUS sp=B8	CNGC 2437	C 1 ST	M46 5400ly (+CNGC 2438 PN)
2447	07 44.6	-23 52	1320	6.2v	OPEN CLUS + DNEB	CNGC 2447	D 6 ST	M93 Includes dark nebula
2451	07 45.4	-37 58	2700	2.8v	OPEN CLUS sp=B5		C 1 ST	1000ly
2467	07 52.5	-26 24	480	7.2p	OPEN CLUS + ENEB		C 6 ST	Open Cluster + Red Nebula
2477	07 52.3	-38 33	1620	5.8v	OPEN CLUS		C 1 ST	
2516	07 58.2	-60 52	1800	3.8v	OPEN CLUS sp=B8		C 1 ST	1200ly
2547	08 10.7	-49 16	1200	4.7v	OPEN CLUS		C 1 ST	
2548	08 13.7	-05 47	3240	5.8v	OPEN CLUS	CNGC 2548	D 1 ST	M48
2631	08 40.2	-53 04	3000	2.5v	OPEN CLUS II 3 p	* IC 2391	C 1 ST	
2632	08 40.1	+19 59	5700	3.1v	OPEN CLUS sp=A0	CNGC 2632	C 1 ST	M44 Praesepe/Beehive 590ly
2682	08 51.1	+11 49	1800	6.9v	OPEN CLUS sp=F2	CNGC 2682	D 1 ST	M67 Very old 2700ly
2808	09 11.9	-64 51	828	6.3v	GLOB CLUS sp=F8		C 2 ST	30kly
2841	09 22.1	+50 58	486	9.3	GALAXY Sb- I	UGC 4966	C 5 ST	8.1x3.8
2903	09 32.1	+21 30	756	8.9	GALAXY Sb+ I-II	UGC 5079	b 5 ST	12.6x6.6
2997	09 45.7	-31 12	486	10.6	GALAXY Sc I	UGC A181	C 5 ST	8.1x6.5
3031	09 55.7	+69 04	1542	6.9	GALAXY Sb I-II	CNGC 3031	C 5 ST	M81 25.7x14.1 Near M82
3034	09 55.9	+69 41	672	8.4	GALAXY P EDGE-ON	UGC 5322	C 5 ST	M82 11.2x4.6 Exploding
3109	10 03.1	-26 10	870	10.4	GALAXY Ir+ IV-V	UGC A194	c 5 ST	14.5x3.5
3114	10 02.7	-60 08	2100	4.2v	OPEN CLUS sp=B5		b 1 ST	2800ly
3115	10 05.3	-07 43	498	9.2	GALAXY E6		c 5 ST	8.3x3.2
3157	10 08.4	+12 18	642	9.9v	GALAXY dE3	* UGC 5470	c 5 S	10.7x8.3
3198	10 20.0	+45 33	498	10.4	GALAXY Sc II	UGC 72	c 5 ST	8.3x3.7
3201	10 17.5	-46 24	1092	6.8v	GLOB CLUS		b 2 ST	
3228	10 21.7	-51 43	1080	6.0v	OPEN CLUSTER		c 1 ST	
3231	10 27.4	-57 38	480	4.3v	OPEN CLUS + DNEB I 3 m n	* IC 2581	c 6 ST	
3234	10 28.5	+68 26	738	10.6	GALAXY S+ IV-V	* IC 2574	c 5 ST	12.3x5.9 UGC 5666
3242	10 24.8	-18 38	1250	8.6p	PLAN NEB		C 4 ST	Ghost of Jupiter
3293	10 35.9	-58 14	360	4.7v	OPEN CLUS + ENEB		c 6 ST	
3324	10 37.5	-58 38	360	6.7v	DIFF ENEB + RNEB + OPEN		c 6 ST	9kly
3328	10 43.2	-64 24	3000	1.9v	OPEN CLUS II 3 m	* IC 2602	b 1 ST	
3351	10 43.9	+11 42	444	9.7	GALAXY S(B)b II	UGC 5850	C 5 ST	M95 7.4x5.1 Near M96
3368	10 46.7	+11 49	426	9.2	GALAXY Sbp	UGC 5882	C 5 ST	M96 7.1x5.1 Near M95
3372	10 45.1	-59 41	7200	5.3	DIFF ENEB + OPEN CLUS HII		A 6 ST	Eta Carina Nebula Red 9kly
3379	10 47.8	+12 35	270	9.3	GALAXY E1 2-SYS	UGC 5902	C A ST	M105 4.5x4.0
3496	10 59.8	-60 20	540	8.2v	OPEN CLUS		c 1 S	
3521	11 05.9	-00 02	570	8.9	GALAXY Sb+ II	UGC 6150	b 5 ST	9.5x5.0
3532	11 06.5	-58 40	3300	3.0v	OPEN CLUS sp=B8		b 1 ST	1400ly
3556	11 11.6	+55 41	498	10.1	GALAXY Sc NEAR EDGE-ON	UGC 6225	C 5 ST	M108 8.3x2.5 Near M97
3572	11 10.5	-60 14	420	6.6v	OPEN CLUS + ENEB		c 6 ST	
3587	11 14.8	+55 02	194	12.0p	PLAN NEB	CNGC 3587	C 4 ST	M97 Owl Nebula 12kly
3604	11 17.9	-62 42	720	8.2p	OPEN CLUS II 3 m	* IC 2714	c 1 ST	
3621	11 18.3	-32 49	600	9.9	GALAXY Sc III-IV	UGC A232	c 5 ST	10.0x6.5
3623	11 18.9	+13 05	600	9.3	GALAXY Sb II:	UGC 6328	C 5 ST	M65 10.0x3.3 Near M66
3627	11 20.2	+12 59	522	9.0	GALAXY Sb+ II:	UGC 6346	C 5 ST	M66 8.7x4.4 Near M65
3628	11 20.3	+13 35	888	9.5	GALAXY Sb NEAR EDGE-ON	UGC 6350	C 5 ST	14.8x3.6
3680	11 25.7	-43 15	720	7.6v	OPEN CLUS		c 1 ST	
3709	11 36.6	-63 02	900	4.5v	OPEN CLUS II 1 p n	* IC 2944	b 1 ST	
3718	11 32.6	+53 04	522	10.5	GALAXY SBap	UGC 624	c 5 ST	8.7x4.5
3766	11 36.2	-61 37	720	5.3v	OPEN CLUS sp=B1		c 1 ST	5800ly
3992	11 57.6	+53 22	456	9.8	GALAXY S(B)b+ I	UGC 6937	D 5 ST	M109 7.6x4.9
4052	12 01.9	-63 12	480	8.8p	OPEN CLUS		c 1 ST	
4111	12 07.1	+43 04	288	10.8	GALAXY S0:	UGC 7103	C 5 ST	4.8x1.1
4192	12 13.9	+14 54	570	10.1	GALAXY Sb I-II: 3-SYS	UGC 7231	D A ST	M98 9.5x3.2
4216	12 15.9	+13 08	498	10.0	GALAXY Sb II	UGC 7284	c 5 ST	8.3x2.2 Near Edge-On
4236	12 16.7	+69 28	1116	9.7	GALAXY SB+ IV	UGC 7306	b 5 ST	18.6x6.9
4244	12 17.6	+37 48	972	10.2	GALAXY S- IV: EDGE-ON	UGC 7322	b 5 ST	16.2x2.5
4254	12 18.9	+14 25	324	9.8	GALAXY Sc I NEAR FACE-ON	UGC 7345	D 5 ST	M99 5.4x4.8
4258	12 19.0	+47 18	1092	8.3	GALAXY Sb+p	UGC 7353	C 5 ST	M106 18.2x7.9
4303	12 22.0	+04 28	360	9.7	GALAXY Sc I 2-SYS	UGC 7420	D A ST	M61 6.0x5.5 Face-On
4321	12 23.0	+15 49	414	9.4	GALAXY Sc I FACE-ON	UGC 7450	D 5 ST	M100 6.9x6.2 Brite Nucleus

CNGC Catalog (continued)

CNGC#	RA	DEC	SIZE	MAG	TYPE & DESCRIPTION	ALT NAME	Q TAGS	COMMON NAME/COMMENTS
4349	12 24.2	-61 54	960	7.4v	OPEN CLUS		c 1 ST	
4374	12 25.1	+12 53	300	9.3	GALAXY E1	UGC 7494	C 5 ST	M84 5.0x4.4 Near M86
4382	12 25.5	+18 11	426	9.2	GALAXY Ep 2-SYS	UGC 7508	C A ST	M85 7.1x5.2
4395	12 25.8	+33 32	774	10.2	GALAXY S+ IV-V	UGC 7524	c 5 S	12.9x11.0
4406	12 26.3	+12 56	444	9.2	GALAXY E3	UGC 7532	C 5 ST	M86 7.4x5.5
4438	12 27.8	+13 00	558	10.1	GALAXY Sap	UGC 7574	c 5 ST	9.3x3.9
4472	12 29.8	+08 00	534	8.4	GALAXY E4	UGC 7629	C 5 ST	M49 8.9x7.4
4486	12 30.9	+12 23	432	8.6	GALAXY E1 + E0 2-SYS	UGC 7654	D A ST	M87 7.2x6.8 + CNGC 4471
4501	12 32.1	+14 25	414	9.5	GALAXY Sb+ I MULTI-ARM	UGC 7675	D 5 ST	M88 6.9x3.9
4517	12 32.8	+00 06	612	10.5	GALAXY Sc 2-SYS	UGC 7694	c A ST	10.2x1.9 Near Edge-On
4548	12 35.5	+14 29	324	10.2	GALAXY SBb + Sc 2-SYS	UGC 7753	D A ST	M91 5.4x4.4 Near CNGC 4571
4552	12 35.7	+12 33	252	9.8	GALAXY E0	UGC 7760	D 5 ST	M89 4.2x4.2
4559	12 36.0	+27 57	630	9.9	GALAXY Sc II-III 3-SYS	UGC 7766	C A ST	10.5x4.9 Coarse Structure
4565	12 36.4	+25 59	972	9.6	GALAXY Sb I: + 3-SYS FNT	UGC 7772	B A ST	M40 16.2x2.8 Edge-On Lane
4569	12 36.9	+13 09	570	9.5	GALAXY Sb+	UGC 7786	C 5 ST	M90 9.5x4.7
4579	12 37.8	+11 49	324	9.8	GALAXY Sb	UGC 7796	C 5 ST	M58 5.4x4.4 Near CNGC 4621
4590	12 39.4	-26 46	720	8.2v	GLOB CLUS	CNGC 4590	D 2 ST	M68
4594	12 39.9	-11 38	534	8.3	GALAXY Sb-	CNGC 4594	C 5 ST	M104 8.9x4.1 "Sombrero"
4605	12 40.0	+61 36	330	11.0	GALAXY SBcp Edge-On	UGC 7831	C 5 ST	5.5x2.3 Edge-On
4609	12 42.4	-62 59	300	6.9v	OPEN CLUS		c 1 ST	
4621	12 42.1	+11 38	306	9.8	GALAXY E3	UGC 7858	D 5 ST	M59 5.1x3.4 Near CNGC 4579
4631	12 42.1	+32 32	906	9.3	GALAXY Sc III Edge-On	UGC 7865	B 5 ST	15.1x3.3 Edge-On
4649	12 43.7	+11 33	432	8.8	GALAXY E1	UGC 7898	D 5 ST	M60 7.2x6.2 Near CNGC 4621
4656	12 43.9	+32 10	828	10.4	GALAXY Sc IV + Ir+ 2-SYS	UGC 7907	C A ST	13.8x3.3 Near CNGC 4631
4725	12 50.5	+25 33	660	9.2	GALAXY S(B)b I	UGC 7989	C 5 ST	11.0x7.9
4736	12 50.9	+41 08	660	8.2	GALAXY Sb-p II:	UGC 7996	C 5 ST	M94 11.0x9.1
4755	12 53.6	-60 21	600	4.2v	OPEN CLUS sp=B3		c 1 ST	Jewel Box 6800ly
4762	12 53.0	+11 14	522	10.2	GALAXY SB0	UGC 8016	c 5 ST	8.7x1.6
4826	12 56.7	+21 41	558	8.5	GALAXY Sb-	UGC 8062	C 5 ST	M64 9.3x5.4 Black Eye Gal
4833	12 59.4	-70 52	810	7.4v	GLOB CLUS		b 2 ST	
4852	13 00.1	-59 36	660	8.9p	OPEN CLUS		c 1 ST	
4945	13 05.3	-49 29	1200	9.5	GALAXY SBc: 2-SYS		b A ST	20.0x4.
5024	13 13.0	+18 10	756	7.7v	GLOB CLUS	CNGC 5024	D 2 ST	M53
5033	13 13.5	+36 36	630	10.1	GALAXY Sb+ I-II:	UGC 8307	c 5 ST	10.5x5.6
5053	13 16.4	+17 40	630	9.8v	GLOB CLUS		c 2 ST	
5055	13 15.8	+42 02	738	8.6	GALAXY Sb+ II	UGC 8334	C 5 ST	M63 12.3x7.6 Sunflower Gal
5102	13 21.9	-36 39	558	10.0	GALAXY S0		c 5 ST	9.3x3.5
5128	13 25.3	-43 01	1092	7.0	GALAXY S0p		B 5 ST	18.2x14.5 Centarus A X-Ray
5138	13 27.3	-59 01	480	7.6v	OPEN CLUS		c 1 ST	
5139	13 26.8	-47 29	2178	3.7v	GLOB CLUS sp=F7	Omega Cen	A 2 ST	Omega Centauri 17kly
5194	13 30.0	+47 11	660	8.4	GALAXY Sc I 2-SYS FACE	UGC 8493	B A ST	M51 11.0x7.8 Whirlpool Gal
5236	13 37.1	-29 51	672	8.2	GALAXY Sc I-II FACE-ON	CNGC 5236	B 5 ST	M83 11.2x10.2
5272	13 42.3	+28 23	972	6.4v	GLOB CLUS sp=F7	CNGC 5272	B 2 ST	M3 35kly
5281	13 46.7	-62 54	300	5.9v	OPEN CLUS		c 1 ST	
5286	13 46.2	-51 22	546	7.6v	GLOB CLUS		b 2 ST	
5316	13 54.0	-61 52	840	6.0v	OPEN CLUS		c 1 ST	
5457	14 03.3	+54 21	1614	7.7	GALAXY Sc I FACE-ON	UGC 8981	C 5 S	M101 26.9x26.3 Pinwheel
5460	14 07.7	-48 19	1500	5.6v	OPEN CLUS		c 1 ST	
5474	14 05.1	+53 40	270	10.9	GALAXY Sc	UGC 9013	C 5 ST	4.5x4.2
5617	14 29.8	-60 44	600	6.3v	OPEN CLUS		c 1 ST	
5662	14 35.1	-56 34	720	5.5v	OPEN CLUS		c 1 ST	
5746	14 45.0	+01 57	474	10.6	GALAXY Sb EDGE-ON	UGC 9499	C 5 ST	7.9x1.7
5749	14 48.9	-54 32	480	8.8p	OPEN CLUS		c 1 ST	
5822	15 05.3	-54 21	2400	6.5p	OPEN CLUS		c 1 ST	
5823	15 05.7	-55 36	600	7.9v	OPEN CLUS		c 1 ST	
5824	15 04.0	-33 05	372	9.0v	GLOB CLUS		c 2 ST	
5897	15 17.4	-21 00	756	8.6v	GLOB CLUS		b 2 ST	
5904	15 18.6	+02 05	1044	5.8v	GLOB CLUS sp=F6	CNGC 5904	B 2 ST	M5 26kly
5907	15 15.9	+56 19	738	10.4	GALAXY Sb+ II:	UGC 9801	C 5 ST	12.3x1.8
5925	15 27.7	-54 32	900	8.4p	OPEN CLUS		c 1 ST	

CNGC Catalog (continued)

CNGC#	RA	DEC	SIZE	MAG	TYPE & DESCRIPTION	ALT NAME	Q TAGS	COMMON NAME/COMMENTS
5927	15 28.0	-50 40	720	8.3v	GLOB CLUS		b 2 ST	
5986	15 46.1	-37 46	588	7.1v	GLOB CLUS		b 2 ST	
6025	16 03.7	-60 30	720	5.1v	OPEN CLUS		c 1 ST	
6067	16 13.3	-54 13	780	5.6v	OPEN CLUS sp=B3		c 1 ST	4700ly
6087	16 18.9	-57 54	720	5.4v	OPEN CLUS		c 1 ST	
6093	16 17.1	-23 00	534	7.2v	GLOB CLUS	CNGC 6093	D 2 ST	M80
6101	16 25.7	-72 13	642	9.3v	GLOB CLUS		c 2 ST	
6121	16 23.7	-26 31	1578	5.9v	GLOB CLUS sp=G0	CNGC 6121	B 2 ST	M4 14kly
6124	16 25.6	-40 42	1740	5.8v	OPEN CLUS		c 1 ST	
6144	16 27.2	-26 03	558	9.1v	GLOB CLUS		c 2 ST	
6152	16 32.8	-52 38	1800	8.1p	OPEN CLUS		c 1 ST	
6167	16 34.4	-49 36	480	6.7v	OPEN CLUS		c 1 ST	
6169	16 34.1	-44 03	420	6.6p	OPEN CLUS		c 1 S	
6171	16 32.5	-13 02	600	8.1v	GLOB CLUS	CNGC 6171	D 2 ST	M107
6192	16 40.4	-43 23	480	8.5p	OPEN CLUS		c 1 ST	
6193	16 41.4	-48 46	900	5.2v	OPEN CLUS + ENEB + RNEB		c 6 ST	
6200	16 44.3	-47 29	720	7.4v	OPEN CLUS		c 1 S	
6205	16 41.7	+36 27	996	5.9v	GLOB CLUS sp=F6	CNGC 6205	B 2 ST	M13 Hercules Globular
6208	16 49.5	-53 49	960	7.2v	OPEN CLUS		c 1 ST	
6218	16 47.2	-01 57	870	6.6v	GLOB CLUS sp=F8	CNGC 6218	D 2 ST	M12 24kly
6231	16 54.3	-41 48	900	2.6v	OPEN CLUS + ENEB sp=O9		b 6 ST	In 240' ENEB 5800ly
6242	16 55.6	-39 30	540	6.4v	OPEN CLUS		c 1 ST	
6250	16 58.0	-45 48	480	5.9v	OPEN CLUS		c 1 ST	
6254	16 57.1	-04 07	906	6.6v	GLOB CLUS sp=G1	CNGC 6254	D 2 ST	M10 20kly
6259	17 00.7	-44 41	600	8.0v	OPEN CLUS		c 1 ST	
6266	17 01.3	-30 07	846	6.6v	GLOB CLUS OBLATE	CNGC 6266	D 2 ST	M62 Non-symmetrical
6273	17 02.6	-26 15	810	7.2v	GLOB CLUS OBLATE	CNGC 6273	D 2 ST	M19 Oblate Shape Globular
6281	17 04.8	-37 53	480	5.4v	OPEN CLUS + ENEB		c 6 ST	
6284	17 04.5	-24 45	336	9.0v	GLOB CLUS		c 2 ST	
6293	17 10.3	-26 34	474	8.2v	GLOB CLUS		c 2 ST	
6304	17 14.6	-29 28	408	8.4v	GLOB CLUS		c 2 ST	
6316	17 16.6	-28 08	294	9.0v	GLOB CLUS		c 2 ST	
6322	17 18.5	-42 57	600	6.0v	OPEN CLUS		c 1 ST	
6333	17 19.2	-18 31	558	7.9v	GLOB CLUS	CNGC 6333	D 2 ST	M9
6341	17 17.2	+43 09	672	6.5v	GLOB CLUS sp=F1	CNGC 6341	D 2 ST	M92 X-Ray Source 26kly
6353	17 24.7	-49 57	720	6.9v	OPEN CLUS II 3 m	* IC 4651	c 1 ST	
6356	17 23.7	-17 49	432	8.4v	GLOB CLUS		c 2 S	
6362	17 31.8	-67 03	642	8.3v	GLOB CLUS		b 2 ST	
6366	17 27.7	-05 05	498	10.0v	GLOB CLUS		c 2 ST	
6367	17 25.2	+37 45	45	14.5	GALAXY		f 5	
6383	17 34.7	-32 35	300	5.5v	OPEN CLUS + ENEB		c 6 ST	ENEB is 80' in diameter
6388	17 36.3	-44 45	522	6.9v	GLOB CLUS		b 2 ST	
6397	17 40.9	-53 41	1542	5.7v	GLOB CLUS sp=F5		b 2 ST	9kly
6398	17 20.2	+57 55	2010	11.9p	GALAXY dE3	* UGC 10822	c 5 S	33.5x18.9 Maybe Can't See
6400	17 40.8	-36 56	480	8.8p	OPEN CLUS		c 1 ST	
6401	17 38.6	-23 55	336	9.5v	GLOB CLUS		d 2 ST	
6402	17 37.6	-03 17	702	7.6v	GLOB CLUS	CNGC 6402	D 2 ST	M14
6405	17 40.1	-32 13	900	4.2v	OPEN CLUS sp=B4	CNGC 6405	C 1 ST	M6 1500ly
6416	17 44.4	-32 21	1080	8.4v	OPEN CLUS		c 1 ST	
6425	17 47.0	-31 31	480	7.2v	OPEN CLUS		c 1 ST	
6431	17 46.3	+05 43	2460	4.2v	OPEN CLUS III 2 p	* IC 4665	b 1 ST	
6432	17 47.9	-30 00	20	13.6p	PLAN NEB	**	f 4 S	PK 359-0.1
6441	17 50.2	-37 03	468	7.4v	GLOB CLUS		c 2 ST	
6451	17 50.7	-30 13	480	8.2p	OPEN CLUS		c 1 ST	
6469	17 52.9	-22 21	720	8.2p	OPEN CLUS		c 1 ST	
6475	17 54.0	-34 49	4800	3.3v	OPEN CLUS sp=B5	CNGC 6475	C 1 ST	M7 800ly
6494	17 57.0	-19 01	1620	5.5v	OPEN CLUS sp=B8	CNGC 6494	D 1 ST	M23 1400ly
6514	18 02.3	-23 02	1740	6.3v	DIFF ENEB + OPEN CLUS HII	CNGC 6514	B 6 ST	M20 Trifid Nebula 3500ly
6520	18 03.5	-27 54	360	6.7p	OPEN CLUS		c 1 ST	
6522	18 03.6	-30 02	336	8.6v	GLOB CLUS		c 2 ST	

CNGC Catalog (continued)

CNGC#	RA	DEC	SIZE	MAG	TYPE & DESCRIPTION	ALT NAME	Q TAGS	COMMON NAME/COMMENTS
6523	18 03.2	-24 23	5400	5.2	OPEN CLUS + ENEB sp=O5	CNGC 6523	B 6 ST	M8 Lagoon Nebula 5100ly
6530	18 04.8	-24 20	900	4.6v	OPEN CLUS + ENEB		b 6 ST	In M8 = Lagoon Nebula
6531	18 04.6	-22 30	780	5.9v	OPEN CLUS	CNGC 6531	D 1 ST	M21
6541	18 08.0	-43 44	786	6.6v	GLOB CLUS sp=F6		b 2 ST	13kly
6543	17 58.6	+66 38	350	8.8p	PLAN NEB		c 4 ST	Blue-Green 300ly
6544	18 07.4	-25 01	534	8.3v	GLOB CLUS		b 2 ST	
6546	18 07.2	-23 19	780	8.0v	OPEN CLUS		c 1 ST	
6553	18 09.5	-25 56	486	8.3v	GLOB CLUS		b 2 ST	
6568	18 12.8	-21 35	780	8.6p	OPEN CLUS		c 1 ST	
6569	18 13.6	-31 49	348	8.7v	GLOB CLUS		c 2 ST	
6595	18 17.0	-19 53	660	7.0p	OPEN CLUS + RNEB		c 6 S	
6611	18 18.8	-13 47	2100	6.0v	OPEN CLUS + ENEB sp=O7	CNGC 6611	D 6 ST	M16 Eagle Nebula 5500ly
6613	18 20.0	-17 08	540	6.9v	OPEN CLUS	CNGC 6613	D 1 ST	M18
6618	18 20.8	-16 11	2760	6.0v	DIFF ENEB + OPEN CLUS HII	CNGC 6618	B 6 ST	M17 Omega/Swan/Horseshoe
6624	18 23.7	-30 21	354	8.3v	GLOB CLUS		c 2 ST	
6626	18 24.6	-24 52	672	6.9v	GLOB CLUS	CNGC 6626	D 2 ST	M28
6630	18 20.0	-18 26	4800	4.7	OPEN CLUS	* CNGC 6630	c 1 T	M24 Best with large field
6633	18 27.5	+06 34	1620	4.6v	OPEN CLUS		b 1 ST	
6634	18 33.5	-19 14	2400	6.5	OPEN CLUS SPARSE	* CNGC 6634	c 1	M25 IC 4725 Sparse Cluster
6637	18 31.4	-32 21	426	7.7v	GLOB CLUS	CNGC 6637	D 2 ST	M69
6642	18 31.5	-23 28	270	8.8v	GLOB CLUS		c 2 ST	
6645	18 32.6	-16 54	600	8.5p	OPEN CLUS		c 1 ST	
6653	18 39.0	+05 27	3120	5.4p	OPEN CLUS III 2 m	* IC 4756	c 1 ST	
6656	18 36.3	-23 56	1440	5.1v	GLOB CLUS sp=F7	CNGC 6656	C 2 ST	M22 10kly
6664	18 36.8	-08 14	960	7.8v	OPEN CLUS		c 1 ST	
6681	18 43.2	-32 18	468	8.1v	GLOB CLUS	CNGC 6681	D 2 ST	M70
6694	18 45.4	-09 24	900	8.0v	OPEN CLUS	CNGC 6694	D 1 ST	M26
6705	18 51.1	-06 16	840	5.8v	OPEN CLUS sp=B8	CNGC 6705	C 1 ST	M11 Very rich 5600ly
6709	18 51.5	+10 21	780	6.7v	OPEN CLUS		c 1 ST	
6712	18 53.1	-08 43	432	8.2v	GLOB CLUS		c 2 ST	
6715	18 55.2	-30 28	546	7.7v	GLOB CLUS	CNGC 6715	D 2 ST	M54
6716	18 54.6	-19 53	420	6.9v	OPEN CLUS		c 1 ST	
6720	18 53.5	+33 02	150	9.7p	PLAN NEB RING-LIKE	CNGC 6720	B 4 ST	M57 Ring Nebula 5kly
6723	18 59.6	-36 38	660	7.3v	GLOB CLUS sp=G4		b 2 ST	24kly
6738	19 01.4	+11 36	900	8.3p	OPEN CLUS		c 1 S	
6744	19 09.8	-63 51	930	9.0	GALAXY S(B)b+ II		b 5 ST	15.5x10.2
6752	19 10.9	-59 59	1224	5.4v	GLOB CLUS sp=F6		b 2 ST	17kly
6755	19 07.8	+04 13	900	7.5v	OPEN CLUS		c 1 ST	
6774	19 16.7	-16 17	2880	9.0	OPEN CLUS		c 1 T	
6779	19 16.6	+30 10	426	8.3v	GLOB CLUS	CNGC 6779	D 2 ST	M56
6791	19 20.8	+37 51	960	9.5v	OPEN CLUS		c 1 ST	
6809	19 40.1	-30 56	1140	7.0	GLOB CLUS sp=F5	CNGC 6809	D 2 ST	M55 20kly
6811	19 38.2	+46 34	780	6.8v	OPEN CLUS		c 1 ST	
6822	19 44.9	-14 46	612	9.4	GALAXY Ir+ IV-V		c 5 ST	10.2x9.5
6823	19 43.2	+23 18	720	7.1v	OPEN CLUS + ENEB		c 6 ST	
6830	19 51.1	+23 05	720	7.9v	OPEN CLUS		c 1 ST	
6838	19 53.7	+18 47	432	8.3v	GLOB CLUS	CNGC 6838	D 2 ST	M71
6853	19 59.6	+22 43	910	7.6p	PLAN NEB	CNGC 6853	B 4 ST	M27 Dumbbell Nebula 3500ly
6864	20 06.2	-21 55	360	8.6v	GLOB CLUS	CNGC 6864	D 2 ST	M75
6871	20 05.9	+35 47	1200	5.2v	OPEN CLUS		c 1 ST	
6882	20 11.7	+26 33	1080	8.1v	OPEN CLUS		c 1 S	
6883	20 11.3	+35 51	900	8.0p	OPEN CLUS		c 1 ST	
6885	20 12.0	+26 29	420	5.7p	OPEN CLUS		c 1 ST	
6888	20 12.8	+38 19	1200	13.0v	DIFF ENEB		c 3 ST	Red
6910	20 23.1	+40 47	480	7.4v	OPEN CLUS + ENEB		c 6 ST	In Gamma Cygnus Nebula
6913	20 23.9	+38 32	420	6.6v	OPEN CLUS	CNGC 6913	D 1 ST	M29
6934	20 34.2	+07 24	354	8.9v	GLOB CLUS		c 2 ST	
6939	20 31.4	+60 38	480	7.8v	OPEN CLUS		c 1 ST	
6940	20 34.6	+28 18	1860	6.3v	OPEN CLUS		c 1 ST	
6946	20 34.8	+60 09	660	8.9	GALAXY Sc I	UGC 11597	b 5 ST	11.0x9.8

CNGC Catalog (continued)

CNGC#	RA	DEC	SIZE	MAG	TYPE & DESCRIPTION	ALT NAME	Q TAGS	COMMON NAME/COMMENTS
6981	20 53.5	-12 33	354	9.4v	GLOB CLUS	CNGC 6981	D 2 ST	M72
6994	20 59.0	-12 37	168	8.9p	OPEN CLUS	CNGC 6994	D 1 ST	M73
7000	21 01.8	+44 12	7200	6.6	DIFF ENEB HII		b 3 ST	North American Nebula 3kly
7009	21 04.3	-11 22	100	8.3p	PLAN NEB		C 4 ST	Saturn Nebula 3000ly
7036	21 12.1	+47 43	240	6.8v	OPEN CLUS I 1 m	* IC 1369	c 1 ST	
7039	21 12.2	+45 39	1500	7.6v	OPEN CLUS		c 1 S	
7063	21 24.4	+36 30	480	7.0v	OPEN CLUS		c 1 S	
7078	21 30.0	+12 10	738	6.4v	GLOB CLUS sp=F2	CNGC 7078	C 2 ST	M15 X-Ray Source 34kly
7082	21 29.4	+47 05	1500	7.2v	OPEN CLUS		c 1 ST	
7086	21 30.6	+51 35	540	8.4v	OPEN CLUS		c 1 ST	
7089	21 33.5	-00 50	774	6.5v	GLOB CLUS sp=F4	CNGC 7089	C 2 ST	M2 40kly
7092	21 32.2	+48 26	1920	4.6v	OPEN CLUS	CNGC 7092	D 1 ST	M39
7093	21 39.1	+57 30	3000	3.5v	OPEN CLUS + DNEB II 3 m n	* IC 1396	b 6 ST	
7099	21 40.3	-23 11	660	7.5v	GLOB CLUS	CNGC 7099	D 2 S	M30
7143	21 53.4	+47 16	540	7.2v	OPEN CLUS + DNEB IV 2 p n	* IC 5146	c 6 ST	
7160	21 53.7	+62 36	420	6.1v	OPEN CLUS		c 1 ST	
7202	22 10.5	+52 50	480	9.0p	OPEN CLUS II 1 p	* IC 1434	c 1 ST	
7209	22 05.2	+46 30	1500	6.7v	OPEN CLUS		c 1 ST	
7243	22 15.3	+49 53	1260	6.4v	OPEN CLUS		c 1 ST	
7331	22 37.1	+34 26	642	9.5	GALAXY Sb I-II	UGC 12113	C 5 ST	10.7x4.0
7380	22 47.0	+58 06	720	7.2v	OPEN CLUS + ENEB		c 6 ST	Red Nebula
7635	23 20.7	+61 12	900	12.8	DIFF ENEB		c 3 ST	Bubble Nebula Red
7640	23 22.1	+40 51	642	10.9	GALAXY S(B)b+ II:	UGC 12554	c 5 ST	10.7x2.5
7654	23 24.2	+61 36	780	6.9v	OPEN CLUS	CNGC 7654	D 1 ST	M52
7686	23 30.2	+49 08	900	5.6v	OPEN CLUS		c 1 ST	
7790	23 58.5	+61 13	1020	8.5v	OPEN CLUS sp=B1		c 1 ST	10300ly
7793	23 57.9	-32 34	546	9.1	GALAXY Sdm III-IV		c 5 ST	9.1x6.6
7815	00 02.1	-15 28	612	10.9	GALAXY Ir+ IV-V	* UGC A444	c 5 S	10.2x4.2

3. STAR Catalog

STAR#	RA	DEC	SIZE	MAG	TYPE & DESCRIPTION	ALT NAME	Q TAGS	COMMON NAME/COMMENTS
* 1	00 08.3	+29 06		2.1v	STAR B8.5p IV:(Hg+Mn)	Alpha And	8 ST	Alpheratz
* 2	00 09.2	+59 10		2.3v	STAR F2 III-IV	Beta Cas	8 ST	Caph
* 3	00 13.2	+15 12		2.8v	STAR B2 IV	Gamma Peg	8 ST	Algenib
* 4	00 25.7	-77 15		2.8v	STAR G1 IV	Beta Hyi	8 ST	
* 5	00 26.3	-42 18		2.4v	STAR K0 IIIb	Alpha Phe	8 ST	Ankaa
* 6	00 39.4	+30 52		3.3v	STAR K3 III	Delta And A	8 ST	
* 7	00 40.5	+56 33		2.2v	STAR K0 IIIa	Alpha Cas	8 ST	Shedir
* 8	00 43.6	-17 59		2.0v	STAR G9.5 III	Beta Cet	8 ST	Diphda
* 9	00 56.7	+60 43	20	2.5v	STAR B0 IVnpe(shell) + ?	Gamma Cas	9 ST	Marj B=8.8
* 10	01 06.1	-46 43	10	3.3v	STAR G8 III	Beta Phe AB	9 ST	B=Similar mag & spectrum
* 11	01 09.8	+35 37		2.1v	STAR M0 IIIa	Beta And	8 ST	Mirach
* 12	01 25.8	+60 15		2.7v	STAR A5 IV	Delta Cas	8 ST	Ruchbah Ecl-Bin @759d
* 13	01 37.7	-57 14		0.5v	STAR B3 Vnp (shell)	Alpha Eri	8 ST	Achernar
* 14	01 54.7	+20 49		2.6v	STAR A5 V	Beta Ari	8 ST	Sharatan
* 15	01 58.7	-61 34		2.9v	STAR A9 III-IVn	Alpha Hyi	8 ST	
* 16	02 04.0	+42 21	100	2.3v	STAR K3 IIb + B9 V + A0 V	Gamma And A	9 ST	Almaak B=5.4 C=6.2
* 17	02 07.2	+23 28		2.0v	STAR K2 IIIab	Alpha Ari	8 ST	Hamal
* 18	02 09.5	+34 59		3.0v	STAR A5 IV	Beta Tri	8 ST	
* 19	02 14.7	+89 17	180	2.0v	STAR F5-8 Ib + F3 V	Alpha UMi A	9 ST	Polaris B=8.2
* 20	02 19.4	-02 58	10	2.1v	STAR M5.5-9 IIIe + Bpe	Omicron Cet A	9 ST	Mira B=9.5
* 21	02 58.3	-40 19		3.2v	STAR A5 IV	Theta Eri A	8 ST	Acamar
* 22	03 02.3	+04 05		2.5v	STAR M1.5 IIIa	Alpha Cet	8 ST	Menkar
* 23	03 04.8	+53 31		2.9v	STAR G8 III + A2 V	Gamma Per	8 ST	
* 24	03 08.2	+40 58		2.1v	STAR B8 V + F:	Beta Per	8 ST	Algol
* 25	03 24.4	+49 52		1.8v	STAR F5 Ib	Alpha Per	8 ST	Mirphak
* 26	03 43.0	+47 48		3.0v	STAR B5 IIIIn	Delta Per	8 ST	
* 27	03 47.6	+27 06		2.9v	STAR B7 IIIIn	Eta Tau	8 ST	Alcyone
* 28	03 47.2	-74 15		3.2v	STAR M2 III	Gamma Hyi	8 ST	
* 29	03 54.2	+31 54	130	2.9v	STAR B1 Ib + B8 V	Zeta Per A	9 ST	B=9.2
* 30	03 57.8	+40 01	90	2.9v	STAR B0.5 IV + B9.5 V	Epsilon Per A	9 ST	B=7.9
* 31	03 58.0	-13 30		3.0v	STAR M0.5 III-IIIb	Gamma Eri	8 ST	Zaurak
* 32	04 34.0	-55 02	2	3.3v	STAR A0p III:(Si) + B9 IV	Alpha Dor AB	9 ST	A=3.8 B=4.3
* 33	04 35.9	+16 31		0.9v	STAR K5 III	Alpha Tau A	8 ST	Aldebaran
* 34	04 49.9	+06 57		3.2v	STAR F6 V	Pi^3 Ori	8 ST	Hassaleh
* 35	04 57.0	+33 11		2.7v	STAR K3 II	Iota Aur	8 ST	Ayn
* 36	05 02.0	+43 49		3.0v	STAR A9 Iae + B	Epsilon Aur A	8 ST	Anz
* 37	05 05.5	-22 22		3.2v	STAR K5 III	Epsilon Lep	8 ST	
* 38	05 06.6	+41 14		3.2v	STAR B3 V	Eta Ori AB	8 ST	Hoedus II
* 39	05 07.9	-05 05		2.8v	STAR A3 IIIIn	Theta Eri	8 ST	Kursa
* 40	05 12.9	-16 12		3.1v	STAR B9p IV: (Hg+Mn)	Mu Lep	8 ST	
* 41	05 14.6	-08 12	90	0.1v	STAR B8 Iae + B5 V	Beta Ori A	9 ST	Rigel B=7.6 C=7.6
* 42	05 16.6	+46 00		0.1v	STAR G6: III + G2: III	Alpha Aur AB	8 ST	Capella
* 43	05 24.5	-02 24		3.3v	STAR B1 IV + B	Eta Ori AB	8 ST	
* 44	05 25.2	+06 21		1.6v	STAR B2 III	Gamma Ori	8 ST	Bellatrix
* 45	05 26.3	+28 37		1.7v	STAR B7 III	Beta Tau	8 ST	Alnath
* 46	05 28.3	-20 46	26	2.8v	STAR G5 II + ?	Beta Lep A	9 ST	B=7.4
* 47	05 32.0	-00 19		2.2v	STAR O9.5 II	Delta Ori A	8 ST	Mintaka
* 48	05 32.7	-17 49		2.6v	STAR F0 Ib	Alpha Lep	8 ST	Arneb
* 49	05 46.5	-05 55	110	2.8v	STAR O9 III + B7 IIIp	Iota Ori A	9 ST	Nair al Saif B=7.3
* 50	05 36.2	-01 12		1.7v	STAR B0 Ia	Epsilon Ori	8 ST	Alnilam
* 51	05 37.6	+21 09		3.0v	STAR B2 IIIpe (shell)	Zeta Tau	8 ST	
* 52	05 39.7	-34 04		2.6v	STAR B7 IV	Alpha Col A	8 ST	Phaet
* 53	05 40.8	-01 56	24	2.1v	STAR O9.5 Ib + B0 III	Zeta Ori A	9 ST	Alnitak B=4.2
* 54	05 47.8	-09 40		2.1v	STAR B0.5 Ia	Kappa Ori	8 ST	Saiph
* 55	05 51.0	-35 46		3.1v	STAR K1.5 III	Beta Col	8 ST	Wezn
* 56	05 55.2	+07 25		0.4v	STAR M2 Iab	Alpha Ori	8 ST	Betelgeuse
* 57	05 59.5	+44 57		1.9v	STAR A1 IV	Beta Aur	8 ST	Menkalinan
* 58	05 59.8	+37 13	40	2.6v	STAR A0p III: (si) + G2 V	Theta Aur AB	9 ST	Bogardus B=7.2 G2V
* 59	06 14.9	+22 31		3.3v	STAR M3 III	Eta Gem	8 ST	Propus
* 60	06 20.3	-30 03		3.0v	STAR B2.5 V	Zeta CMa	8 ST	Phurud

STAR Catalog (continued)

STAR#	RA	DEC	SIZE	MAG	TYPE & DESCRIPTION	ALT NAME	Q TAGS	COMMON NAME/COMMENTS
* 61	06 22.9	+22 31		2.8v	STAR M3 IIIab	Mu Gem	8 ST	Tejat Posterior
* 62	06 22.7	-17 58		2.0v	STAR B1 II-III	Beta CMa	8 ST	Murzim
* 63	06 24.0	-52 42		-0.7v	STAR A9 II	Alpha Car	8 ST	Canopus
* 64	06 37.7	+16 24		1.9v	STAR A1 IVs	Gamma Gem	8 ST	Alhena
* 65	06 37.7	-43 12		3.2v	STAR B8 IIIIn	Nu Pup	8 ST	
* 66	06 44.0	+25 08		3.0v	STAR G8 Ib	Epsilon Gem	8 ST	Mebsuta
* 67	06 45.2	-16 43	95	-1.5v	STAR A0mA1 Va	Alpha CMa A	9 ST	Sirius B=8.5 50y
* 68	06 48.2	-61 56		3.3v	STAR A6 Vn	Alpha Pic	8 ST	
* 69	06 49.9	-50 37		2.9v	STAR K1 III	Tau Pup	8 ST	
* 70	06 58.6	-28 58		1.5v	STAR B2 II	Epsilon CMa A	8 ST	Adara
* 71	07 03.1	-23 50		3.0v	STAR B3 lab	Omicron^2 CMa	8 ST	
* 72	07 08.4	-26 23		1.8v	STAR F8 Ia	Delta CMa	8 ST	Wezen
* 73	07 13.5	-44 38		2.6v	STAR M5 IIIe	L2 Pup	8 ST	HR2748
* 74	07 17.2	-37 05		2.7v	STAR K3 Ib	Pi Pup	8 ST	
* 75	07 24.2	-26 19		2.5v	STAR B5 Ia	Eta CMa	8 ST	Aludra
* 76	07 27.2	+08 17		2.9v	STAR B8 V	Beta CMi	8 ST	Gomeisa
* 77	07 29.3	-43 17	220	3.3v	STAR K5 III + G5: V	Sigma Pup A	9 ST	
* 78	07 34.6	+31 53	25	1.9v	STAR A1 V + A2mA5	Alpha Gem A	9 ST	Castor A
* 79	07 34.6	+31 53	25	2.9v	STAR A2mA5 + A1 V	Alpha Gem B	9 ST	Castor B
* 80	07 39.3	+05 14	40	0.4v	STAR F5 IV-V + ?	Alpha CMi A	9 ST	Procyon B=10.3
* 81	07 45.4	+28 02		1.1v	STAR K0 IIIb	Beta Gem	8 ST	Pollux
* 82	07 49.3	-24 52		3.3v	STAR G6 Ib	Xi Pup	8 ST	
* 83	08 03.7	-30 01		2.3v	STAR O5 Iafn	Zeta Pup	8 ST	Naos
* 84	08 07.6	-24 19		2.7v	STAR F6 IIp (var)	Rho Pup	8 ST	
* 85	08 09.5	-47 21		1.7v	STAR WC8 + O9 I:	Gamma^2 Vel	8 ST	
* 86	08 22.5	-59 31		1.9v	STAR K3: III	Epsilon Car	8 ST	Avior
* 87	08 44.7	-54 43	20	2.0v	STAR A1 IV	Delta Vel AB	9 ST	B=5.0
* 88	08 55.5	+05 56		3.1v	STAR G9 II-III	Zeta Hya	8 ST	
* 89	08 59.3	+48 03	40	3.1v	STAR A7 IVn + M1 V	Iota UMa A	9 ST	Talitha BC=10.8
* 90	09 08.0	-43 25		2.2v	STAR K4 Ib-IIa	Lambda Vel	8 ST	Suhail
* 91	09 13.3	-69 44		1.7v	STAR A1 III	Beta Car	8 ST	Miaplacidus
* 92	09 17.1	-59 17		2.2v	STAR A8 II	Iota Car	8 ST	Turais
* 93	09 21.1	+34 23		3.1v	STAR K7 IIIab	Alpha Lyn	8 ST	
* 94	09 22.1	-55 01		2.5v	STAR B2 IV-V	Kappa Vel	8 ST	
* 95	09 27.6	-08 39		2.0v	STAR K3 II-III	Alpha Hya	8 ST	Alphard
* 96	09 31.2	-57 01		3.1v	STAR K5 III	N Vel	8 ST	HR3803
* 97	09 33.0	+51 41		3.2v	STAR F6 IV	Theta UMa	8 ST	
* 98	09 45.9	+23 46		3.0v	STAR G1 II	1 Leo	8 ST	Ras Elased Aus
* 99	09 47.2	-65 05	50	3.0v	STAR A5 Ib + B7 III	Nu Car AB	9 ST	B=6.3
*100	10 08.5	+11 58		1.4v	STAR B7 Vn	Alpha Leo A	8 ST	Regulus
*101	10 13.7	-70 02		3.3v	STAR B8 IIIIn	Omega Car	8 ST	
*102	10 20.0	+19 51	50	2.6v	STAR K1 IIIb Fe-0.5 + *	Gamma Leo A	9 ST	Algieba B=3.5 G7 III Fe-1
*103	10 22.4	+41 30		3.1v	STAR M0 IIIp	Mu Uma	8 ST	Tania Australis
*104	10 32.0	-61 42		3.3v	STAR B4 Vne	Rho Car	8 ST	HR4140
*105	10 43.0	-64 24		2.8v	STAR B0.5 Vp	Theta Car	8 ST	
*106	10 46.8	-49 26	20	2.7v	STAR G5 III + F8: V	Mu Vel AB	9 ST	B=6.4
*107	10 49.7	-16 11		3.1v	STAR K2 III	Ny Hya	8 ST	
*108	11 01.9	+56 23		2.4v	STAR A0mA1 IV-V	Beta UMa	8 ST	Merak
*109	11 03.8	+61 45	3	1.8v	STAR K0 IIIa + A8 V	Alpha UMa AB	9 ST	Dubhe B=4.8
*110	11 09.7	+44 30		3.0v	STAR K1 III	Psi UMa	8 ST	
*111	11 14.2	+20 32		2.6v	STAR A4 V	Delta Leo	8 ST	Zosma
*112	11 14.2	+15 26		3.3v	STAR A2 Vs	Theta Leo	8 ST	Chort
*113	11 35.8	-63 02		3.1v	STAR B9 III	Lambda Cen	8 ST	
*114	11 49.1	+14 34		2.1v	STAR A3 V	Beta Leo	8 ST	Denebola
*115	11 53.8	+53 41		2.4v	STAR A0 IV-Vn	Gamma UMa	8 ST	Phad
*116	12 08.4	-50 44		2.5v	STAR B2 IVne	Delta Cen	8 ST	
*117	12 10.1	-22 37		3.0v	STAR K3 IIIa	Epsilon Crv	8 ST	Minkar
*118	12 15.1	-58 45		2.8v	STAR B2 IV	Delta Cru	8 ST	
*119	12 15.5	+57 01		3.3v	STAR A2 IV-Vn	Delta UMa	8 ST	Megrez
*120	12 15.8	-17 33		2.6v	STAR B8p III: (Hg+Mn)	Gamma Crv	8 ST	Gienah Ghurab

STAR Catalog (continued)

STAR#	RA	DEC	SIZE	MAG	TYPE & DESCRIPTION	ALT NAME	Q TAGS	COMMON NAME/COMMENTS
*121	12 26.6	-63 06	50	1.3v	STAR B0.5 IV + B1 Vn	Alpha Cru A	9 ST	Acrux A B=1.7
*122	12 26.7	-63 07	50	1.7v	STAR B1 Vn + B0.5 IV	Alpha Cru B	9 ST	Acrux B A=1.3
*123	12 29.9	-16 31	240	3.0v	STAR B9.5 III + K2 V	Delta Crv A	9 ST	Algorab B=8.3
*124	12 31.2	-57 07		1.6v	STAR M3.5 III	Gamma Cru	8 ST	Gacrux
*125	12 34.4	-23 24		2.7v	STAR G5 II	Beta Crv	8 ST	Kraz
*126	12 37.2	-69 09		2.7v	STAR B2 IV-V	Alpha Mus	8 ST	
*127	12 41.6	-48 58	50	2.9v	STAR B9.5 III + A0 III	Gamma Cen A	9 ST	B=3.0
*128	12 41.5	-48 58	50	3.0v	STAR A0 III + B9.5 III	Gamma Cen B	9 ST	A=2.9
*129	12 41.7	-01 28	40	2.8v	STAR F1 V + F1 V	Gamma Vir AB	9 ST	Porrira B=3.5
*130	12 46.2	-68 07	10	3.1v	STAR B2 V + B2.5 V	Beta Mus AB	9 ST	B=4.1
*131	12 47.7	-59 42		1.2v	STAR B0.5 III	Beta Cru	8 ST	Becrux Mimosa
*132	12 54.0	+55 58		1.8v	STAR A0p IV: (Cr+Eu)	Epsilon UMa	8 ST	Alioth
*133	12 56.1	+38 19		2.9v	STAR A0p III: (Si+Eu+Sr)	Alpha^2 CVn A	8 ST	Cor Caroli B=5.6 F0 V
*134	13 02.2	+10 58		2.8v	STAR G9 IIIab	Epsilon Vir	8 ST	Vindamatrix
*135	13 19.0	-23 11		3.0v	STAR G8 IIIa	Gamma Hya	8 ST	
*136	13 20.6	-36 43		2.8v	STAR A2 V	Iota Cen	8 ST	
*137	13 24.0	+54 55	140	2.3v	STAR A1p IV: (Si) + A1mA7	Zeta UMa A	9 ST	Mizar B=3.9
*138	13 25.2	-11 10		1.0v	STAR B1 V	Alpha Vir	8 ST	Spica
*139	13 39.9	-53 28		2.3v	STAR B1 III	Epsilon Cen	8 ST	
*140	13 47.6	+49 19		1.9v	STAR B3 V	Eta UMa	8 ST	Alcaid
*141	13 49.6	-42 28		3.0v	STAR B2 IV-Vpne	Mu Cen	8 ST	
*142	13 54.7	+18 24		2.7v	STAR G0 IV	Eta Boo	8 ST	Mufrid
*143	13 55.6	-47 17		2.6v	STAR B2.5 IV	Zeta Cen	8 ST	
*144	14 03.9	-60 24		0.6v	STAR B1 III	Beta Cen AB	8 ST	Hadar
*145	14 06.4	-26 41		3.3v	STAR K2 IIIb	Pi Hya	8 ST	
*146	14 06.7	-36 22		2.1v	STAR K0 IIIb	Theta Cen	8 ST	Menkent
*147	14 15.7	+19 11		0.0v	STAR K1.5 III Fe-0.5	Alpha Boo	8 ST	Arcturus
*148	14 32.1	+38 19		3.0v	STAR A7 III-IV	Gamma Boo	8 ST	Seginus
*149	14 35.5	-42 10		2.4	STAR B1.5 IVpne	Eta Cen	8 ST	
*150	14 39.8	-60 51	210	0.0v	STAR G2 V + K4 V	Alpha Cen A	9 ST	Rigel Kentaurus B=1.3
*151	14 39.8	-60 51	210	1.3v	STAR K4 V + G2 V	Alpha Cen B	9 ST	A=0.0
*152	14 41.9	-47 24		2.3v	STAR B1.5 III	Alpha Lup	8 ST	
*153	14 42.5	-64 59	160	3.2v	STAR A7p (Sr) + K5 V	Alpha Cir	9 ST	B=8.6
*154	14 46.6	+27 04	30	2.4v	STAR K0 II-III + A0 V	Epsilon Boo	9 ST	Izar B=5.1
*155	14 51.1	-51 03		2.8v	STAR A3 IV	Alpha Lib A	8 ST	Zuben Elgenubi
*156	14 50.6	+74 10		2.1v	STAR K4 III	Beta UMi	8 ST	Kocab
*157	14 58.5	-43 08		2.7v	STAR B2 IV	Beta Lup	8 ST	
*158	14 59.2	-42 06		3.1v	STAR B2 V	Kappa Cen	8 ST	
*159	15 04.1	-25 18		3.3v	STAR M4 III	Sigma Lib	8 ST	Brachium
*160	15 17.1	-09 23		2.6v	STAR B8 Vn	Beta Lib	8 ST	Zuben Elschemali
*161	15 18.9	-68 41		2.9v	STAR A1 IIIIn	Gamma TrA	8 ST	
*162	15 21.4	-40 39		3.2v	STAR B1.5 IVn	Delta Lup	8 ST	
*163	15 20.7	+71 50		3.1v	STAR A2.5 III	Gamma UMi	8 ST	Pherkad
*164	15 24.9	+58 58		3.3v	STAR K2 III	Iota Dra	8 ST	Ed Asich
*165	15 35.5	+26 43		2.2v	STAR A0 IV	Gamma CrB	8 ST	Alphekka
*166	15 35.1	-41 10	5	2.8v	STAR B2 IVn + B2 IVn	Alpha Lup AB	9 ST	A=3.5 B=3.6
*167	15 54.3	+06 25		2.7v	STAR K2 IIIb (CN1)	Alpha Ser	8 ST	Unukalhai
*168	15 55.1	-63 26		2.9v	STAR F0 IV	Beta Tra	8 ST	
*169	15 58.9	-26 08		2.9v	STAR B1 V + B2 V	Pi Sco A	8 ST	
*170	15 59.5	+25 54		2.0v	STAR gM3: + Bep	T CrB	8 ST	Galt
*171	16 00.3	-22 38		2.3v	STAR B0.3 IV	Delta Sco AB	8 ST	Dschubba
*172	16 05.5	-19 48	10	2.6v	STAR B0.5 IV	Beta Sco AB	9 ST	Graffias B=5.0 C=4.9 @ 14"
*173	16 14.3	-03 43		2.7v	STAR M0.5 III	Delta Oph	8 ST	Yed Prior
*174	16 18.3	-04 36		3.2v	STAR G9.5 IIIb Fe-0.5	Epsilon Oph	8 ST	Yed Posterior
*175	16 21.2	-25 36	200	2.9v	STAR B1 III + B9 V	Sigma Sco A	9 ST	Alniyat B=8.3
*176	16 24.0	+61 31	60	2.7v	STAR G8 IIIab	Eta Dra A	9 ST	B=8.7
*177	16 29.5	-26 26	30	0.9v	STAR M1.5 lab + B2.5 V	Alpha Sco A	9 ST	Antares B=5.4
*178	16 30.2	+21 29		2.8v	STAR G7 IIIa	Beta Her	8 ST	Kornephoros
*179	16 35.9	-28 13		2.8v	STAR B0 V	Tau Sco	8 ST	
*180	16 37.2	-10 34		2.6v	STAR O9.5 Vn	Zeta Oph	8 ST	Fieht

STAR Catalog (continued)

STAR#	RA	DEC	SIZE	MAG	TYPE & DESCRIPTION	ALT NAME	Q TAGS	COMMON NAME/COMMENTS
*181	16 41.3	+31 36	11	2.8v	STAR G1 IV + G7 V	Zeta Her AB	9 ST	B=5.5
*182	16 48.7	-69 02		1.9v	STAR K2 IIb - IIIa	Alpha TrA	8 ST	Artia
*183	16 50.2	-34 17		2.3v	STAR K2 III	Epsilon Sco	8 ST	
*184	16 51.9	-38 03		3.0v	STAR B1.5 IVn	Mu^1 Sco	8 ST	
*185	16 57.7	+09 22		3.2v	STAR K2 III	Kappa Oph	8 ST	
*186	16 58.7	-56 00	10	3.1v	STAR K4 III	Zeta Ara	8 ST	
*187	17 08.7	+65 43		3.2v	STAR B6 III	Zeta Dra	8 ST	Aldhibah
*188	17 10.4	-15 44		2.4v	STAR A2 Vs + A3 V	Eta Oph AB	9 ST	Sabik A=3.0 B=3.5
*189	17 12.2	-43 14		3.3v	STAR F2p V: (Cr)	Eta Sco	8 ST	
*190	17 14.7	+14 23		3.1v	STAR M5 Ib-II	Alpha Her AB	8 ST	Ras Algethi
*191	17 15.1	+24 50	90	3.1v	STAR A1 IVn + ?	Delta Her	9 ST	Sarin B=8.8
*192	17 15.1	+36 48		3.2v	STAR K3 IIab	Pi Her	8 ST	
*193	17 22.1	-25 00		3.3v	STAR B2 IV	Alpha Oph	8 ST	
*194	17 25.4	-55 32		2.9v	STAR K3 Ib-IIa	Beta Ara	8 ST	
*195	17 25.5	-56 23		3.3v	STAR B1 Ib	Gamma Ara A	8 ST	
*196	17 30.8	-37 17	40	2.7v	STAR B2 IV	Upsilon Sco	8 ST	
*197	17 30.4	+52 19		2.8v	STAR G2 Ib-IIa + ?	Beta Dra A	9 ST	Restaban B=11.5
*198	17 31.9	-49 52		3.0v	STAR B2 Vne	Alpha Ara	8 ST	
*199	17 33.7	-37 07		1.6v	STAR B1.5 IV	Lambda Sco	8 ST	Shaula
*200	17 25.0	+12 33		2.1v	STAR A5 IIIIn	Alpha Oph	8 ST	Rasalhague
*201	17 37.3	-43 00		1.9v	STAR F1 II	Theta Sco	8 ST	Sargas
*202	17 42.6	-39 02		2.4v	STAR B1.5 III	Kappa Sco	8 ST	
*203	17 43.5	+04 34		2.8v	STAR K2 III	Beta Oph	8 ST	Cebalrai
*204	17 47.6	-40 07		3.0	STAR F2 Ia	Iota^1 Sco	8 ST	
*205	17 49.9	-37 02		3.2v	STAR K2 III	G Sco	8 ST	HR6630
*206	17 56.6	+51 29	40	2.2v	STAR K5 III	Gamma Dra	8 ST	Etamin
*207	17 59.1	-09 46		3.3v	STAR K0 III	Nu Oph	8 ST	
*208	18 05.8	-30 26		3.0v	STAR K0 III	Gamma^2 Sgr	8 ST	Nash
*209	18 17.7	-36 46		3.1v	STAR M3.5 IIIab + G8: IV:	Eta Sgr A	9 ST	B=8.3
*210	18 21.0	-29 50		2.7v	STAR K2.5 IIIa	Delta Sgr	8 ST	
*211	18 21.3	-02 54		3.3v	STAR K0 III-IV	Eta Ser	8 ST	
*212	18 24.2	-34 23		1.9v	STAR A0 IIIInp (shell)	Epsilon Sgr	8 ST	Kaus Australis
*213	18 28.0	-25 25		2.8v	STAR K1 IIIb	Lambda Sgr	8 ST	Kaus Borealis
*214	18 37.0	+38 47		0.0v	STAR A0 Va	Alpha Lyr	8 ST	Vega
*215	18 45.7	-26 59		3.2v	STAR B8.5 III	Phi Sgr	8 ST	
*216	18 55.3	-26 18	5	2.0v	STAR B2.5 V	Sigma Sgr	8 ST	Nunki
*217	18 58.9	+32 41		3.2v	STAR B9 III	Gamma Lyr	8 ST	Sulaphat
*218	19 02.7	-29 53		2.6v	STAR A2.5 V + A4: V:	Zeta Sgr AB	9 ST	Ascella A=3.2 B=3.5
*219	19 05.5	+13 53		3.0v	STAR A0 IVnn	Zeta Aql A	8 ST	
*220	19 07.0	-27 39		3.3v	STAR K1.5 IIIb	Tau Sgr	8 ST	
*221	19 09.8	-21 02	6	2.9v	STAR F2 II + ? + ?	Pi Sgr ABC	9 ST	Albaldah A=3.7 B=3.8
*222	19 12.6	+67 39		3.1v	STAR G9 III	Delta Dra	8 ST	Nodus Secundus
*223	19 30.8	+27 58		3.1v	STAR K3 II + B9.5 V	Beta Cyg A	9 ST	Albireo B=5.1
*224	19 45.0	+45 08		2.9v	STAR B9.5 III + F1 V	Delta Cyg AB	9 ST	B=6.4
*225	19 46.3	+10 37		2.7v	STAR K3 II	Gamma Aql	8 ST	Tarazed
*226	19 50.8	+08 52		0.8v	STAR A7 Vn	Alpha Aql	8 ST	Altair
*227	20 11.3	-00 50		3.2v	STAR B9.5 III	Theta Aql	8 ST	
*228	20 21.1	-14 46		3.1v	STAR K0 II + A5 V:n	Beta Cap A	8 ST	Dabih
*229	20 22.2	+40 16		2.2v	STAR F8 Ib	Gamma Cyg	8 ST	Sadr
*230	20 26.9	+15 05		1.9v	STAR B2.5 V	Alpha Pav	8 ST	Peacock
*231	20 37.6	-47 18		3.1v	STAR K0 III (Cn1)	Alpha Ind	8 ST	
*232	20 41.5	+45 17		1.3v	STAR A2 Ia	Alpha Cyg	8 ST	Deneb
*233	20 46.3	+33 58		2.5v	STAR K0 III	Epsilon Cyg	8 ST	Cat
*234	21 13.0	+30 13		3.2v	STAR G8 IIIa Ba 0.6	Zeta Cyg	8 ST	
*235	21 18.6	+62 36		2.4v	STAR A7 IV-V	Alpha Cep	8 ST	Alderamin
*236	21 28.7	+70 33		3.2v	STAR B1 III	Beta Cep	8 ST	Alphirk
*237	21 31.6	-05 35		2.9v	STAR G0 Ib	Beta Aqr	8 ST	Sadalsuud
*238	21 44.2	+09 53		2.4v	STAR K2 Ib	Epsilon Peg	8 ST	Enif '72 flare
*239	21 47.1	-16 07		2.9v	STAR A3mF2 V:	Delta Cap	8 ST	
*240	21 54.0	-37 22		3.0v	STAR B8 III	Gamma Gru	8 ST	

STAR Catalog (continued)

STAR#	RA	DEC	SIZE	MAG	TYPE & DESCRIPTION	ALT NAME	Q TAGS	COMMON NAME/COMMENTS
*241	22 05.8	-00 19		3.0v	STAR G2 Ib	Alpha Aqr	8 ST	Sadalmelik
*242	22 08.3	-46 58		1.7v	STAR B7 IV	Alpha Gru	8 ST	Al Nair
*243	22 18.6	-60 16		2.9v	STAR K3 III	Alpha Tuc	8 ST	
*244	22 42.7	-46 52		2.1v	STAR M5 III	Beta Gru	8 ST	
*245	22 43.1	+30 14		2.9v	STAR G8 II + F0 V	Eta Peg	8 ST	Matar
*246	22 53.6	-15 50		3.3v	STAR A3 IV	Delta Aqr	8 ST	Skat
*247	22 57.7	-29 38		1.2v	STAR A3 V	Alpha PsA	8 ST	Fomalhaut
*248	23 03.8	+28 05		2.4v	STAR M2 II-III	Beta Peg	8 ST	Scheat
*249	23 04.8	+15 12		2.5v	STAR B9.5 V	Alpha Peg	8 ST	Markab
*250	23 39.4	+77 38		3.2v	STAR K1 III-IV	Gamma Cep	8 ST	Alrai
*251	00 06.1	+58 26	15	6.4	STAR 6.4:7.2 @308	ADS 61	9 ST	1980=1.4 @287 107y
*252	00 40.0	+21 27	66	5.5	STAR 5.5:8.7 @194	ADS 558	9 ST	1964 Yellow:Blue
*253	00 42.4	+04 11	15	7.8	STAR 7.8:9.4 @207	ADS 588	9 ST	1980=1.5 @ 200
*254	00 49.9	+27 42	44	6.3	STAR 6.3:6.3 @296	ADS 683	9 ST	1959 p(Yellow:Blue)
*255	00 54.6	+19 11	5	6.2	STAR 6.2:6.9 @211	ADS 746	9 ST	1980=0.5 @ 224 400y
*256	00 55.0	+23 38	8	6.0	STAR 6.0:6.4 @292	ADS 755	9 ST	1980=0.6 @ 259
*257	01 05.7	+21 28	299	5.6	STAR 5.6:5.8 @159	ADS 899	9 ST	1964 Yellow:pBlue
*258	01 09.5	+47 15	5	4.6	STAR 4.6:5.5 @133	ADS 940	9 ST	1980=0.5 @ 140
*259	01 13.7	+07 35	230	5.6	STAR 5.6:6.6 @063	ADS 996	9 ST	1972 Yellow:pBlue
*260	01 39.8	-56 12	113	5.8	STAR 5.8:5.8 @193	p Eri	9 ST	1980=11.1 @195
*261	02 35.5	+89 35	178	2.0	STAR 2.0:8.9 @216	ADS 1477	9 ST	Polaris North Star
*262	01 53.6	+19 18	78	4.6	STAR 4.6:4.7 @000	ADS 1507	9 ST	1969 1831=8.6
*263	01 55.9	+01 51	10	6.8	STAR 6.8:6.8 @057	ADS 1538	9 ST	1980=1.2 @053
*264	01 57.9	+23 36	385	4.7	STAR 4.7:7.7 @047	ADS 1563	9 ST	1973 Yellow:Blue
*265	02 02.0	+02 46	16	4.2	STAR 4.2:5.2 @273	ADS 1615	9 ST	pBlue:pGreen
*266	02 03.9	+42 20	98	2.2	STAR 2.2:5.1 @063	ADS 1630	9 ST	1967 Orange:Emerald
*267	02 12.4	+30 18	39	5.3	STAR 5.3:6.9 @071	ADS 1697	9 ST	1959 Yellow:Blue
*268	02 14.0	+47 29	11	6.6	STAR 6.6:7.1 @274	ADS 1709	9 ST	1980=1.1 @266
*269	02 29.1	+67 25	25	4.6	STAR 4.6:6.9 @232	ADS 1860	9 ST	1980=2.4 @234
*270	02 37.0	+24 39	383	6.6	STAR 6.6:7.4 @276	ADS 1982	9 ST	1973 Yellow:pBlue
*271	02 43.3	+03 15	28	3.6	STAR 3.6:6.2 @297	ADS 2080	9 ST	1974 Yellow:Ashen
*272	03 14.1	+00 11	11	8.8	STAR 8.8:8.8 @139	ADS 2416	9 ST	1980=1.0 @144
*273	03 17.8	+38 38	8	7.8	STAR 7.8:8.3 @259	ADS 2446	9 ST	1980=0.9 @265
*274	03 35.0	+60 02	14	6.8	STAR 6.8:7.6 @261	ADS 2612	9 ST	1980=1.3 @258
*275	03 34.5	+24 28	7	6.6	STAR 6.6:6.7 @002	ADS 2616	9 ST	1980=0.6 @006
*276	03 50.3	+25 35	4	5.8	STAR 5.8:6.2 @211	ADS 2799	9 ST	1980=0.6 @207
*277	03 54.3	-02 57	67	4.7	STAR 4.7:6.2 @347	ADS 2850	9 ST	Fixed
*278	04 09.9	+80 42	7	5.5	STAR 5.5:6.3 @120	ADS 2963	9 ST	1980=0.8 @109
*279	04 07.5	+38 05	16	7.4	STAR 7.4:8.9 @353	ADS 2995	9 ST	1980=1.4 @003
*280	04 16.0	+31 42	7	8.0	STAR 8.0:8.1 @275	ADS 3082	9 ST	1980=0.8 @270
*281	04 20.4	+27 21	496	5.1	STAR 5.1:8.5 @496	ADS 3137	9 ST	1973 Yel/Ora:Blue
*282	04 22.8	+15 03	14	7.3	STAR 7.3:8.5 @352	ADS 3169	9 ST	Purple:Blue
*283	05 07.9	+08 30	7	5.8	STAR 5.8:6.5 @349	ADS 3711	9 ST	1980=0.7 @021
*284	05 14.5	-08 12	92	0.2	STAR 0.2:6.7 @206	ADS 3823	9 ST	Rigel
*285	05 35.2	+09 56	43	3.6	STAR 3.6:5.5 @044	ADS 4179	9 ST	1959 Yellow:Purple
*286	05 35.3	-05 23	132	5.1	STAR 5.4:6.8:6.8	ADS 4186	9 ST	Trapezium in M42
*287	06 28.8	-07 02	99	4.6	STAR 4.6:5.1:5.4	ADS 5107	9 ST	Fixed White Stars
*288	06 46.3	+59 27	17	5.4	STAR 5.4:6.0 @074	ADS 5400	9 ST	1980=1.7 @079
*289	06 45.3	-16 42	45	-1.5	STAR -1.5:8.5 @005	ADS 4523	9 ST	1980=10.3 @049
*290	07 12.8	+27 14	13	7.2	STAR 7.2:7.2 @316	ADS 5871	9 ST	1980=1.3 @320 120y
*291	07 30.3	+49 59	8	8.8	STAR 8.8:8.8 @195	ADS 6117	9 ST	1980=0.8 @189
*292	07 34.6	+31 53	30	1.9	STAR 1.9:2.9 @073	ADS 6175	9 ST	1980=2.2 @095 420y
*293	08 12.2	+17 39	6	5.6	STAR 5.6:6.0 @182	ADS 6650	9 ST	Yellow:Yellow:Blue
*294	09 21.1	+38 11	11	6.5	STAR 6.5:6.7 @271	ADS 7307	9 ST	1980=1.1 @254
*295	10 16.3	+17 44	14	7.2	STAR 7.2:7.5 @181	ADS 7704	9 ST	1980=1.4 @183
*296	10 20.0	+19 51	44	2.2	STAR 2.2:3.5 @124	ADS 7724	9 ST	1980=4.3 @123
*297	11 18.3	+31 32	13	4.3	STAR 4.3:4.8 @060	ADS 8119	9 ST	1980=2.9 @105
*298	11 32.4	+61 05	6	5.8	STAR 5.8:7.1 @295	ADS 8197	9 ST	1980=0.4 @211
*299	12 16.1	+40 39	115	5.9	STAR 5.9:9.0 @260	ADS 8489	9 ST	1925 Gold:Blue
*300	12 24.4	+25 35	16	6.8	STAR 6.8:7.8 @325	ADS 8539	9 ST	1980=1.5 @326

STAR Catalog (continued)

STAR#	RA	DEC	SIZE	MAG	TYPE & DESCRIPTION	ALT NAME	Q TAGS	COMMON NAME/COMMENTS
*301	12 26.6	-63 06	47	1.6	STAR 1.6:2.1 @114	Alpha Cru	9 ST	1943 White:White
*302	12 35.1	+18 22	202	5.2	STAR 5.2:6.8 @271	ADS 8600	9 ST	1963 Yellow:vBlue
*303	12 41.7	-01 28	30	3.5	STAR 3.5:3.5 @287	ADS 8630	9 ST	1980=3.9 @297 White
*304	12 53.3	+21 15	8	5.1	STAR 5.1:7.2 @194	ADS 8695	9 ST	1980=0.8 @175
*305	13 23.9	+54 55	144	2.3	STAR 2.3:4.0 @151	ADS 8891	9 ST	1967
*306	13 49.1	+26 59	34	7.6	STAR 7.6:8.0 @167	ADS 9031	9 ST	1980=3.4 @159
*307	14 15.3	+03 08	12	7.8	STAR 7.8:7.9 @239	ADS 9182	9 ST	1980=1.1 @252
*308	14 20.4	+48 30	13	8.1	STAR 8.1:8.3 @105	ADS 9229	9 ST	1980=1.2 @104 White
*309	14 40.0	-60 51	197	0.0	STAR 0.0:1.2 @214	Alpha Cen	9 ST	1980=21.8 @209
*310	14 41.2	+13 44	10	4.5	STAR 4.5:4.6 @160	ADS 9343	9 ST	1980=1.1 @305 White
*311	14 45.0	+27 04	28	2.5	STAR 2.5:5.0 @339	ADS 9372	9 ST	1971 Orange:Green
*312	14 51.4	+19 06	70	4.7	STAR 4.7:6.9 @326	ADS 9413	9 ST	Orange:Blue
*313	14 51.4	+44 56	11	8.4	STAR 8.4:8.6 @348	ADS 9418	9 ST	1980=1.1 @346
*314	15 18.4	+26 50	15	7.3	STAR 7.3:7.4 @255	ADS 9578	9 ST	1980=1.4 @250
*315	15 23.2	+30 17	10	5.6	STAR 5.6:5.9 @027	ADS 9617	9 ST	1980=0.4 @321
*316	15 24.5	+37 20	22	7.0	STAR 7.0:7.6 @012	ADS 9626	9 ST	1980=2.2 @016
*317	15 34.8	+10 32	39	4.1	STAR 4.1:5.2 @179	ADS 9701	9 ST	1960 Yel-Whi:Ashen
*318	15 39.4	+36 38	63	5.1	STAR 5.1:6.0 @305	ADS 9737	9 ST	1957
*319	16 04.4	-11 22	7	4.9	STAR 4.9:4.9 @044	ADS 9909	9 ST	1980=1.2 @021
*320	16 14.7	+33 51	69	5.6	STAR 5.6:6.6 @235	ADS 9979	9 ST	1980=6.7 @233
*321	16 29.4	-26 26	24	0.9v	STAR 0.9:5.5 @276	ADS 10074	9 ST	Antares Red:pGreen
*322	16 28.9	+18 24	17	7.7	STAR 7.7:7.8 @129	ADS 10075	9 ST	1980=1.4 @136
*323	16 30.9	+01 59	15	4.2	STAR 4.2:5.2 @022	ADS 10087	9 ST	1980=1.3 @013
*324	16 56.5	+65 02	14	7.1	STAR 7.1:7.3 @069	ADS 10279	9 ST	1980=1.3 @069
*325	17 05.4	+54 28	19	5.7	STAR 5.7:5.7 @025	ADS 10345	9 ST	1980=1.9 @042
*326	17 15.4	-26 35	48	5.1	STAR 5.1:5.1 @151	ADS 10417	9 ST	Orange:Orange
*327	17 14.7	+14 24	47	3.2	STAR 3.2:5.4 @107	ADS 10418	9 ST	1968 Yellow:Blue
*328	17 23.7	+37 08	40	4.6	STAR 4.6:5.5 @316	ADS 10526	9 ST	1964
*329	18 01.5	+21 36	65	5.1	STAR 5.1:5.2 @258	ADS 10993	9 ST	1953 Yellow:pRed
*330	18 03.1	-08 11	18	5.2	STAR 5.2:5.9 @280	ADS 11005	9 ST	1980=1.9 @277
*331	18 05.3	+02 32	15	4.2	STAR 4.2:6.0 @220	ADS 11046	9 ST	Yel-Ora:Ora
*332	18 25.0	+27 24	7	6.5	STAR 6.5:7.5 @126	ADS 11334	9 ST	1980=0.7 @129
*333	18 35.8	+16 58	15	6.8	STAR 6.8:7.0 @155	ADS 11483	9 ST	1980=1.6 @161
*334	18 44.4	+39 40	26	5.0	STAR 5.0:6.1 @353	ADS 11635	9 ST	1980=2.7 @355 White
*335	18 44.4	+39 36	24	5.2	STAR 5.2:5.5 @080	ADS 11635	9 ST	1980=2.3 @084 White
*336	18 57.1	+32 54	10	5.4	STAR 5.4:7.5 @021	ADS 11871	9 ST	1980=1.1 @051
*337	19 06.4	-37 03	13	4.8	STAR 4.8:5.1 @109	Gamma CrA	9 ST	1980=1.5 @157
*338	19 26.5	+27 19	20	8.1	STAR 8.1:8.4 @292	ADS 12447	9 ST	1980=1.8 @293
*339	19 30.7	+27 58	344	3.2	STAR 3.2:5.4 @054	ADS 12540	9 ST	1967 Gold:Blue
*340	19 45.5	+33 37	24	8.3	STAR 8.3:8.4 @349	ADS 12889	9 ST	1980=2.0 @357
*341	20 21.0	-14 46	2050	3.1	STAR 3.1:6.2 @267	Beta Cap	9 ST	Yellow:Blue
*342	20 46.6	+16 08	98	4.3	STAR 4.3:5.2 @268	ADS 14279	9 ST	1967 Gold:Blue-Gre
*343	20 47.5	+36 29	9	4.9	STAR 4.9:6.1 @011	ADS 14296	9 ST	White:pBlue
*344	20 59.1	+04 18	10	6.0	STAR 6.0:6.3 @285	ADS 14499	9 ST	1980=1.1 @286
*345	21 02.3	+07 11	28	7.3	STAR 7.3:7.5 @217	ADS 14556	9 ST	1961
*346	21 06.7	+38 42	297	5.2	STAR 5.2:6.0 @148	ADS 14636	9 ST	1980=29.0 @146
*347	22 28.8	+00 15	19	4.3	STAR 4.3:4.5 @207	ADS 15971	9 ST	pYellow:pBlue
*348	22 28.2	+57 42	33	9.8	STAR 9.8:11.5 @132	ADS 15972	9 ST	1980=2.6 @176 Reds
*349	22 33.0	+69 55	4	6.5	STAR 6.5:7.0 @094	ADS 16057	9 ST	1980=0.5 @086
*350	23 34.0	+31 20	4	5.6	STAR 5.6:5.7 @280	ADS 16836	9 ST	1980=0.4 @267
*351	21 12.3	-88 58		5.5	STAR VAR 5.3-5.7 FOIII	Sigma Oct	8 ST	S-Pole * Sigma Oct

4. M (Messier) Catalog

M#	RA	DEC	SIZE	MAG	TYPE & DESCRIPTION	ALT NAME	Q TAGS	COMMON NAME/COMMENTS
M 1	05 34.5	+22 01	360	8.4	PLAN NEB EMIS SN REM	CNGC 1952	B 4 ST	M1 Crab Nebula 4kly
M 2	21 33.5	-00 50	774	6.5v	GLOB CLUS sp=F4	CNGC 7089	C 2 ST	M2 40kly
M 3	13 42.3	+28 23	972	6.4v	GLOB CLUS sp=F7	CNGC 5272	B 2 ST	M3 35kly
M 4	16 23.7	-26 31	1578	5.9v	GLOB CLUS sp=G0	CNGC 6121	B 2 ST	M4 14kly
M 5	15 18.6	+02 05	1044	5.8v	GLOB CLUS sp=F6	CNGC 5904	B 2 ST	M5 26kly
M 6	17 40.1	-32 13	900	4.2v	OPEN CLUS sp=B4	CNGC 6405	C 1 ST	M6 1500ly
M 7	17 54.0	-34 49	4800	3.3v	OPEN CLUS sp=B5	CNGC 6475	C 1 ST	M7 800ly
M 8	18 03.2	-24 23	5400	5.2	OPEN CLUS + ENEB sp=O5	CNGC 6523	B 6 ST	M8 Lagoon Nebula 5100ly
M 9	17 19.2	-18 31	558	7.9v	GLOB CLUS	CNGC 6333	D 2 ST	M9
M 10	16 57.1	-04 07	906	6.6v	GLOB CLUS sp=G1	CNGC 6254	D 2 ST	M10 20kly
M 11	18 51.1	-06 16	840	5.8v	OPEN CLUS sp=B8	CNGC 6705	C 1 ST	M11 Very rich 5600ly
M 12	16 47.2	-01 57	870	6.6v	GLOB CLUS sp=F8	CNGC 6218	D 2 ST	M12 24kly
M 13	16 41.7	+36 27	996	5.9v	GLOB CLUS sp=F6	CNGC 6205	B 2 ST	M13 Hercules Globular
M 14	17 37.6	-03 17	702	7.6v	GLOB CLUS	CNGC 6402	D 2 ST	M14
M 15	21 30.0	+12 10	738	6.4v	GLOB CLUS sp=F2	CNGC 7078	C 2 ST	M15 X-Ray Source 34kly
M 16	18 18.8	-13 47	2100	6.0v	OPEN CLUS + ENEB sp=O7	CNGC 6611	D 6 ST	M16 Eagle Nebula 5500ly
M 17	18 20.8	-16 11	2760	6.0v	DIFF ENEB + OPEN CLUS HII	CNGC 6618	B 6 ST	M17 Omega/Swan/Horseshoe
M 18	18 20.0	-17 08	540	6.9v	OPEN CLUS	CNGC 6613	D 1 ST	M18
M 19	17 02.6	-26 15	810	7.2v	GLOB CLUS OBLATE	CNGC 6273	D 2 ST	M19 Oblate Shape Globular
M 20	18 02.3	-23 02	1740	6.3v	DIFF ENEB + OPEN CLUS HII	CNGC 6514	B 6 ST	M20 Trifid Nebula 3500ly
M 21	18 04.6	-22 30	780	5.9v	OPEN CLUS	CNGC 6531	D 1 ST	M21
M 22	18 36.3	-23 56	1440	5.1v	GLOB CLUS sp=F7	CNGC 6656	C 2 ST	M22 10kly
M 23	17 57.0	-19 01	1620	5.5v	OPEN CLUS sp=B8	CNGC 6494	D 1 ST	M23 1400ly
M 24	18 20.0	-18 26	4800	4.7	OPEN CLUS	CNGC 6630	c 1 T	M24 Best with large field
M 25	18 33.5	-19 14	2400	6.5	OPEN CLUS SPARSE	CNGC 6634	c 1	M25 IC 4725 Sparse Cluster
M 26	18 45.4	-09 24	900	8.0v	OPEN CLUS	CNGC 6694	D 1 ST	M26
M 27	19 59.6	+22 43	910	7.6p	PLAN NEB	CNGC 6853	B 4 ST	M27 Dumbbell Nebula 3500ly
M 28	18 24.6	-24 52	672	6.9v	GLOB CLUS	CNGC 6626	D 2 ST	M28
M 29	20 23.9	+38 32	420	6.6v	OPEN CLUS	CNGC 6913	D 1 ST	M29
M 30	21 40.3	-23 11	660	7.5v	GLOB CLUS	CNGC 7099	D 2 S	M30
M 31	00 42.8	+41 17	10680	3.5	GALAXY Sb I-II	UGC 454	B 5 ST	M31 Andromeda Gal 178x63
M 32	00 42.8	+40 53	456	8.2	GALAXY E2	UGC 452	C 5 ST	M32 Comp of M31 7.6x5.8
M 33	01 33.9	+30 40	3720	5.7	GALAXY Sc II-III	UGC 1117	C 5 ST	M33 Triangulum Gal 62x39
M 34	02 42.0	+42 47	2100	5.2v	OPEN CLUS	CNGC 1039	C 1 ST	M34
M 35	06 08.9	+24 21	1680	5.1v	OPEN CLUS sp=B5	CNGC 2168	C 1 ST	M35 2800ly
M 36	05 36.2	+34 08	720	6.0v	OPEN CLUS	CNGC 1960	C 1 ST	M36
M 37	05 52.4	+32 33	1440	5.6v	OPEN CLUS sp=B8	CNGC 2099	C 1 ST	M37 4200ly
M 38	05 28.7	+35 51	1260	6.4v	OPEN CLUS sp=B5	CNGC 1912	C 1 ST	M38 4600ly
M 39	21 32.2	+48 26	1920	4.6v	OPEN CLUS	CNGC 7092	D 1 ST	M39
M 40	12 36.4	+25 59	972	9.6	GALAXY Sb I: + 3-SYS FNT	UGC 7772	B A ST	M40 16.2x2.8 Edge-On Lane
M 41	06 47.1	-20 45	2280	4.5v	OPEN CLUS sp=B4	CNGC 2287	C 1 ST	M41 2200ly
M 42	05 35.3	-05 23	3960	3.9	DIFF RNEB + ENEB	CNGC 1976	A 3 ST	M42 Orion Nebula Blue+Red
M 43	05 35.5	-05 16	1200	5.8	DIFF RNEB + ENEB	CNGC 1982	C 3 ST	M43 Orion Nebula Extension
M 44	08 40.1	+19 59	5700	3.1v	OPEN CLUS sp=A0	CNGC 2632	C 1 ST	M44 Praesepe/Beehive 590ly
M 45	03 47.1	+24 07	7200	1.6	OPEN CLUS + RNEB sp=B6	CNGC 1457	c 6 ST	M45 Pleiades 410ly
M 46	07 41.9	-14 49	1620	6.1v	OPEN CLUS sp=B8	CNGC 2437	C 1 ST	M46 5400ly (+CNGC 2438 PN)
M 47	07 36.6	-14 29	1800	4.4v	OPEN CLUS sp=B3	CNGC 2422	D 1 ST	M47 1600ly
M 48	08 13.7	-05 47	3240	5.8v	OPEN CLUS	CNGC 2548	D 1 ST	M48
M 49	12 29.8	+08 00	534	8.4	GALAXY E4	UGC 7629	C 5 ST	M49 8.9x7.4
M 50	07 02.9	-08 20	960	5.9v	OPEN CLUS	CNGC 2323	D 1 ST	M50
M 51	13 30.0	+47 11	660	8.4	GALAXY Sc I 2-SYS FACE	UGC 8493	B A ST	M51 11.0x7.8 Whirlpool Gal
M 52	23 24.2	+61 36	780	6.9v	OPEN CLUS	CNGC 7654	D 1 ST	M52
M 53	13 13.0	+18 10	756	7.7v	GLOB CLUS	CNGC 5024	D 2 ST	M53
M 54	18 55.2	-30 28	546	7.7v	GLOB CLUS	CNGC 6715	D 2 ST	M54
M 55	19 40.1	-30 56	1140	7.0	GLOB CLUS sp=F5	CNGC 6809	D 2 ST	M55 20kly
M 56	19 16.6	+30 10	426	8.3v	GLOB CLUS	CNGC 6779	D 2 ST	M56
M 57	18 53.5	+33 02	150	9.7p	PLAN NEB RING-LIKE	CNGC 6720	B 4 ST	M57 Ring Nebula 5kly
M 58	12 37.8	+11 49	324	9.8	GALAXY Sb	UGC 7796	C 5 ST	M58 5.4x4.4 Near CNGC 4621
M 59	12 42.1	+11 38	306	9.8	GALAXY E3	UGC 7858	D 5 ST	M59 5.1x3.4 Near CNGC 4579
M 60	12 43.7	+11 33	432	8.8	GALAXY E1	UGC 7898	D 5 ST	M60 7.2x6.2 Near CNGC 4621

M (Messier) Catalog (continued)

M#	RA	DEC	SIZE	MAG	TYPE & DESCRIPTION	ALT NAME	Q TAGS	COMMON NAME/COMMENTS
M 61	12 22.0	+04 28	360	9.7	GALAXY Sc I 2-SYS	UGC 7420	D A ST	M61 6.0x5.5 Face-On
M 62	17 01.3	-30 07	846	6.6v	GLOB CLUS OBLATE	CNGC 6266	D 2 ST	M62 Non-symmetrical
M 63	13 15.8	+42 02	738	8.6	GALAXY Sb+ II	UGC 8334	C 5 ST	M63 12.3x7.6 Sunflower Gal
M 64	12 56.7	+21 41	558	8.5	GALAXY Sb-	UGC 8062	C 5 ST	M64 9.3x5.4 Black Eye Gal
M 65	11 18.9	+13 05	600	9.3	GALAXY Sb II:	UGC 6328	C 5 ST	M65 10.0x3.3 Near M66
M 66	11 20.2	+12 59	522	9.0	GALAXY Sb+ II:	UGC 6346	C 5 ST	M66 8.7x4.4 Near M65
M 67	08 51.1	+11 49	1800	6.9v	OPEN CLUS sp=F2	CNGC 2682	D 1 ST	M67 Very old 2700ly
M 68	12 39.4	-26 46	720	8.2v	GLOB CLUS	CNGC 4590	D 2 ST	M68
M 69	18 31.4	-32 21	426	7.7v	GLOB CLUS	CNGC 6637	D 2 ST	M69
M 70	18 43.2	-32 18	468	8.1v	GLOB CLUS	CNGC 6681	D 2 ST	M70
M 71	19 53.7	+18 47	432	8.3v	GLOB CLUS	CNGC 6838	D 2 ST	M71
M 72	20 53.5	-12 33	354	9.4v	GLOB CLUS	CNGC 6981	D 2 ST	M72
M 73	20 59.0	-12 37	168	8.9p	OPEN CLUS	CNGC 6994	D 1 ST	M73
M 74	01 36.7	+15 47	612	9.2	GALAXY Sc I	UGC 1149	D 5 ST	M74 10.2x9.5
M 75	20 06.2	-21 55	360	8.6v	GLOB CLUS	CNGC 6864	D 2 ST	M75
M 76	01 42.0	+51 34	290	12.2	PLAN NEB PART OF 0651	CNGC 0650	C 4 ST	M76 Little Dumbbell Nebula
M 77	02 42.7	-00 01	414	8.8	GALAXY Sbp SEYFERT	UGC 2188	D 5 ST	M77 6.9x5.9 Seyfert Galaxy
M 78	05 46.8	+00 03	480	11.3	DIFF RNEB	CNGC 2068	C 3 ST	M78 Blue 1500ly
M 79	05 24.2	-24 31	522	8.0v	GLOB CLUS	CNGC 1904	D 2 ST	M79
M 80	16 17.1	-23 00	534	7.2v	GLOB CLUS	CNGC 6093	D 2 ST	M80
M 81	09 55.7	+69 04	1542	6.9	GALAXY Sb I-II	CNGC 3031	C 5 ST	M81 25.7x14.1 Near M82
M 82	09 55.9	+69 41	672	8.4	GALAXY P EDGE-ON	UGC 5322	C 5 ST	M82 11.2x4.6 Exploding
M 83	13 37.1	-29 51	672	8.2	GALAXY Sc I-II FACE-ON	CNGC 5236	B 5 ST	M83 11.2x10.2
M 84	12 25.1	+12 53	300	9.3	GALAXY E1	UGC 7494	C 5 ST	M84 5.0x4.4 Near M86
M 85	12 25.5	+18 11	426	9.2	GALAXY Ep 2-SYS	UGC 7508	C A ST	M85 7.1x5.2
M 86	12 26.3	+12 56	444	9.2	GALAXY E3	UGC 7532	C 5 ST	M86 7.4x5.5
M 87	12 30.9	+12 23	432	8.6	GALAXY E1 + E0 2-SYS	UGC 7654	D A ST	M87 7.2x6.8 + CNGC 4471
M 88	12 32.1	+14 25	414	9.5	GALAXY Sb+ I MULTI-ARM	UGC 7675	D 5 ST	M88 6.9x3.9
M 89	12 35.7	+12 33	252	9.8	GALAXY E0	UGC 7760	D 5 ST	M89 4.2x4.2
M 90	12 36.9	+13 09	570	9.5	GALAXY Sb+	UGC 7786	C 5 ST	M90 9.5x4.7
M 91	12 35.5	+14 29	324	10.2	GALAXY SBb + Sc 2-SYS	UGC 7753	D A ST	M91 5.4x4.4 Near CNGC 4571
M 92	17 17.2	+43 09	672	6.5v	GLOB CLUS sp=F1	CNGC 6341	D 2 ST	M92 X-Ray Source 26kly
M 93	07 44.6	-23 52	1320	6.2v	OPEN CLUS + DNEB	CNGC 2447	D 6 ST	M93 Includes dark nebula
M 94	12 50.9	+41 08	660	8.2	GALAXY Sb-p II:	UGC 7996	C 5 ST	M94 11.0x9.1
M 95	10 43.9	+11 42	444	9.7	GALAXY S(B)b II	UGC 5850	C 5 ST	M95 7.4x5.1 Near M96
M 96	10 46.7	+11 49	426	9.2	GALAXY Sbp	UGC 5882	C 5 ST	M96 7.1x5.1 Near M95
M 97	11 14.8	+55 02	194	12.0p	PLAN NEB	CNGC 3587	C 4 ST	M97 Owl Nebula 12kly
M 98	12 13.9	+14 54	570	10.1	GALAXY Sb I-II: 3-SYS	UGC 7231	D A ST	M98 9.5x3.2
M 99	12 18.9	+14 25	324	9.8	GALAXY Sc I NEAR FACE-ON	UGC 7345	D 5 ST	M99 5.4x4.8
M100	12 23.0	+15 49	414	9.4	GALAXY Sc I FACE-ON	UGC 7450	D 5 ST	M100 6.9x6.2 Brite Nucleus
M101	14 03.3	+54 21	1614	7.7	GALAXY Sc I FACE-ON	UGC 8981	C 5 S	M101 26.9x26.3 Pinwheel
M102	15 06.5	+55 45	312	10.0	GALAXY E6p 2-SYS	UGC 9723	D A ST	M102 5.2x2.3
M103	01 33.3	+60 43	360	7.4v	OPEN CLUS	CNGC 0581	D 1 ST	M103
M104	12 39.9	-11 38	534	8.3	GALAXY Sb-	CNGC 4594	C 5 ST	M104 8.9x4.1 "Sombrero"
M105	10 47.8	+12 35	270	9.3	GALAXY E1 2-SYS	UGC 5902	C A ST	M105 4.5x4.0
M106	12 19.0	+47 18	1092	8.3	GALAXY Sb+p	UGC 7353	C 5 ST	M106 18.2x7.9
M107	16 32.5	-13 02	600	8.1v	GLOB CLUS	CNGC 6171	D 2 ST	M107
M108	11 11.6	+55 41	498	10.1	GALAXY Sc NEAR EDGE-ON	UGC 6225	C 5 ST	M108 8.3x2.5 Near M97
M109	11 57.6	+53 22	456	9.8	GALAXY S(B)b+ I	UGC 6937	D 5 ST	M109 7.6x4.9
M110	00 40.4	+41 42	1044	8.0	GALAXY E6:	UGC 426	C 5 ST	M110 Comp of M31 17.4x9.8

APPENDIX E: MAINTAINING YOUR LX200

1. Keeping Your Telescope Clean

Prevention is the best recommendation that a telescope owner can follow to keep astronomical equipment in top working order. Proper measures taken during observation and when storing equipment between observing runs can add many years of trouble free use.

Dust and moisture are the two main enemies to your instrument. When observing, it is advisable to use a proper fitting dew shield. The dew shield not only prevents dew from forming, and dust from settling on the corrector plate lens, it prevents stray light from reducing image contrast.

Although dew shields go a long way to prevent moisture build-up, there can be times when the telescope optics will have a uniform coating of moist dew. This is not particularly harmful, as long as the instrument is allowed to let the dew evaporate. This can be done with a hair dryer, or just setting up the telescope indoors with the dust covers removed. It is also advisable that you let the foam lined case for the LX200 dry out indoors for a day if the night was moist. Packing your telescope away in a moist case can result in giving it a steam bath later.

CAUTION: Anytime the LX200 is being stored or transported, be sure to release the R.A. and Dec. locks, to prevent serious damage to the drive gears.

CAUTION: Never attempt to wipe down optics that are covered with dew. Dust and dirt may be trapped with the collected dew, and upon wiping the optics you may scratch them. After the dew has evaporated you will most likely find them in fine condition for the next observing session.

If you live in a very moist climate, you may find it necessary to use silica desiccant stored in the telescope's case to ward off moisture and the possibility of fungus growing on and within the coatings of the optics. Replace the desiccant as often as necessary.

Those living in coastal areas or tropic zones should also cover the electronic ports on the power panel and the keypad with gaffers tape to reduce corrosion on the metal contacts. Apply a dab of a water displacement solution (*i.e.* WD-40) with a small brush on all interior metal contacts and the input cord metal contacts. The keypad and all separate accessories should be kept in sealable plastic bags with silica desiccant.

A thick layer of dust will attract and absorb moisture on all exposed surfaces. Left unattended, it can cause damaging corrosion. To keep dust at bay when observing, the telescope can be set up on a small section of indoor/outdoor carpet. If you are observing for more than one night in a row, the telescope can be left set up but covered with a large plastic bag (such as the one supplied with the telescope). The rear cell opening of the LX200 can also be sealed off to the elements by threading on the optional accessory Skylight 1A Dust Seal. Eyepieces, diagonals, and other accessories are best kept in plastic bags and stored in cases, such as the Meade #50 Accessory Case.

All of the non optical surfaces of the LX200 should be cleaned routinely with a soft rag and alcohol to prevent corrosion. The cast metal surfaces and the individual exposed screws can also be kept looking new and corrosion free by wiping them down with a water displacement solution. Take care not to smear the solution onto any optical surface, and to wipe up any excess solution with a clean dry cloth. The painted tube can be polished with a liquid car polish and a soft rag.

Surprisingly, **the most common telescope maintenance error is cleaning the optics too often.** A little dust on any of the optical surfaces causes virtually zero degradation of optical performance. It should be of no concern whatsoever to see

some small particles on the inside or outside of telescope optics. Should the optics get more dust on them than you would care for, simply use a photographic grade camel hair brush with very gentle strokes. You can also blow off dust with an ear syringe (available from a local pharmacy).

There is a point, however, when the optics must be cleaned. This is when you can easily tell that there is a thin layer of fine particulates that make the optics look very slightly hazy. To clean the optics we must suggest that you make your own lens cleaning solutions, since it is impossible to know all of the ingredients used in commercial lens cleaners. Pure isopropyl alcohol (90% or better) will clean most residual film build-up on optical surfaces (and metal surfaces too).

Organic materials (*e.g.*, fingerprints) on the front lens may be removed with a solution of 3 parts distilled water to 1 part isopropyl alcohol. A single drop of biodegradable dishwashing soap may be added per pint of solution. Use soft, white facial tissues and make short, gentle strokes. Change tissues often.

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

Sprayer bottles are a convenient dispenser of lens cleaning solutions onto the tissues. Use soft, white facial tissues and make short, gentle strokes. Change tissues often. If the optics are small (such as viewfinders or eyepieces), the tissue can be rolled to the appropriate thickness and then broken in half to create two cleaning wands. It is advised that you avoid many of the so-called lens cleaning papers (many which contain fiberglass), lens cloths, or chamois.

Before attempting to clean an optical surface with a liquid solution, it is very important that as much dust as possible is removed by using forced air and/or gentle strokes with a photographic grade camel hair brush. The forced air can come from a rubber ear syringe, or canned compressed air from a photographic supply store. Be sure to hold the canned air in a vertical position and try spraying compressed air on your hand before aiming at the optics to see if any of the propellant (solid material) comes out. Propellant is very difficult to remove from optics, so take care not to tip the can when using it. If you have access to a compressor hose, be sure that it is filtered to prevent oil from being sprayed on the optics.

Once you are confident that you have removed most of the dust and large particles, begin cleaning with the mixture described above. Pour or spray enough solution onto a pillow or wand of tissue until it is quite wet. If you are cleaning a corrector plate, use radial strokes with a smooth pillow of tissue, starting from the center out, using no pressure. If you are cleaning small optical surfaces, use the rolled wands of tissue starting from the edges then spiraling in to the center, again using no pressure. Never pour or spray the solution onto the corrector plate or eyepieces themselves, as the liquid may go behind or in between lenses, where it is difficult or impossible to reach. Never attempt to disassemble an eyepiece to clean the inner elements, as you will certainly not be able to properly center and re-assemble the optical train.

Use dry tissue to make the final clean up, again using no pressure. If there is still some sort of residue, repeat the procedure using the three part formula described above, again using the same cleaning techniques.

The inside surface of the corrector plate and secondary mirror may at some point become dirty due to particles falling inside the tube when removing or replacing the rear dust cover or threading on accessories. To reduce the chance of interior contamination, the Meade Skylight 1A Dust Seal is very effective. If the Dust Seal is not used, it helps to have the rear cell pointed downward when replacing the rear dust cover or attaching accessories.

Another more serious, but not damaging problem is the possibility of a hazy (usually uneven) film building up on the inside of the corrector plate. This can be caused by

environmental pollutants, or temperature changes reacting with the interior paint, causing outgassing or water condensation, or combinations thereof.

It is possible to clean the interior of the optical system yourself or to have it done professionally. In the case of the former, take great care in handling the optics. Any impact or rough handling can damage the surfaces, which may require complete optical replacement at Meade Instruments at substantial cost. Meade Instruments assumes no liability for damage incurred to the telescope by the customer.

The cleaning techniques described above are used while cleaning the interior of the optical system, with one exception: **Do not apply cleaning solutions to the front surface mirrored optics. Only use the soft camel hair brush and the suggested ear syringe for removing particles.** The corrector plate can be cleaned in the normal manner.

To remove the corrector plate, follow the instructions below:

- Remove the six (8" and 12" models) or the eight (10" model) stainless steel screws that hold the corrector plate retaining ring with the raised white lettering in place. This should be done with the Drive Base placed flat on a work bench, and the optical tube assembly pointed up at a 45-degree angle with the declination lock secure to prevent accidental dislodging of the corrector plate.
- Remove the plastic retaining ring and locate the two white alignment marks, one at the edge of the corrector plate lens and one beside it on the black metal front cell. These two marks line up and serve as the precise rotational position of the corrector plate in the optical train. If no marks exist, make them yourself with a small paintbrush and some white paint, so that when you return the corrector plate to the front cell you are putting it back in the same position that you took it off.
- Remove the corrector plate from the telescope, holding it by the plastic central secondary housing. Gently flip it over so that the secondary mirror is facing you, then reinsert the corrector plate back into the front cell. This will allow you full access to clean the interior optical surfaces without touching them with your fingers.
- When cleaning is complete, replace the corrector plate in its original position, carefully lining up the rotational index marks described in paragraph b, above. Then replace the retainer. Partially thread in all of the stainless steel screws, then, one at a time, snug the screws down to prevent the corrector plate from rotating in the front cell. Take care not to overtighten the screws as it will stress the corrector plate lens.
- A final check of the optical system is to inspect for proper collimation (alignment) of the optics.

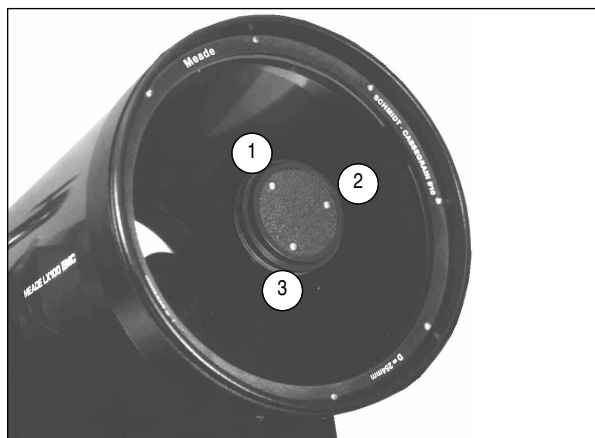


Fig. 26: Collimation of the Optical System. (1), (2), (3) Set screws for adjusting collimation.

2. Collimation of the Optical System

The optical collimation (alignment) of any astronomical telescope used for serious purposes is important, but in cases of the Schmidt-Cassegrain design of the 8", 10", and 12" LX200, such collimation is absolutely essential for good performance. Take special care to read and understand this section well so that your LX200 will give you the best optical performance.

NOTE: The 7" LX200 does not require collimation.

For final optical tests, every Meade Schmidt-Cassegrain is precisely collimated at the factory before shipment. Our company is well aware that through shipment and normal handling, the optical alignment can be degraded. The design of the optical support system make the method of collimation easy to do. Even the uninitiated can make an alignment of the optics to the same high precision that is performed at the Meade Instruments Optical Laboratories.

To check the collimation of your LX200, center a bright star that is overhead, or use a reflected "hot spot" of reflected sunlight from a chrome car bumper or a telephone pole insulator, with the supplied 26mm eyepiece. To make a correct evaluation of the alignment it helps if the telescope has been allowed to either cool down or warm up to the ambient temperature where the instrument is set up. Temperature differences between the optics and the outside air can cause distortion in the images.

With the star or hot spot centered, de-focus the image. You will notice that the out of focus star image looks like a ring of light (the dark center of the ring is the shadow of the secondary mirror). Turn the focus knob until the ring of light fills about 1/8th of the eyepiece field. Take note that if you keep de-focusing the star past about 1/8th of a field, that the ring will look perfectly concentric (even on all sides) even if the optics are out of alignment, thus preventing you from seeing any misalignments. If the ring of light does not seem to be even on all sides, or if the dark center seems to be offset in the in the ring of light, follow the method below:

- To make collimation easy, the only adjustments possible on the 8", 10", and 12" LX200 come from the three set screws (1, 2, and 3, Fig.26) located at the edge of the outer surface of the secondary mirror housing.

WARNING: DO NOT FORCE THE 3 COLLIMATION SCREWS PAST THEIR NORMAL TRAVEL AND DO NOT LOOSEN THEM MORE THAN 2 FULL TURNS (COUNTER-CLOCKWISE DIRECTION), OR THE SECONDARY MIRROR MAY COME LOOSE FROM ITS SUPPORT. YOU WILL FIND THAT THE ADJUSTMENTS ARE VERY SENSITIVE: USUALLY, ONLY TURNING A COLLIMATION SCREW 1/2 A TURN WILL GIVE DRAMATIC RESULTS.

- While looking at the de-focused star image and noticing which direction the darker shadow is offset in the ring of light or noticing which part of the ring is the thinnest (1, Fig. 27), place your index finger in front of the telescope so that it touches one of the collimation set screws. You will see the shadow of your finger in the ring of light. Move your finger (or an assistants finger) around the edge of the black plastic secondary mirror support until you see the shadow of the finger crossing the thinnest part of the ring of light. At this point, look at the front of the telescope where your (or your assistants) finger is aiming. It will either be pointing directly at a set screw, or it will be between two set screws aiming at the set screw on the far side of the black plastic secondary mirror support. This is the set screw that you will adjust.
- Using the telescope's slow motion controls, move the de-focused image to the edge of the eyepiece field of view (2, Fig. 27), in the same direction as the darker shadow is offset in the ring of light.

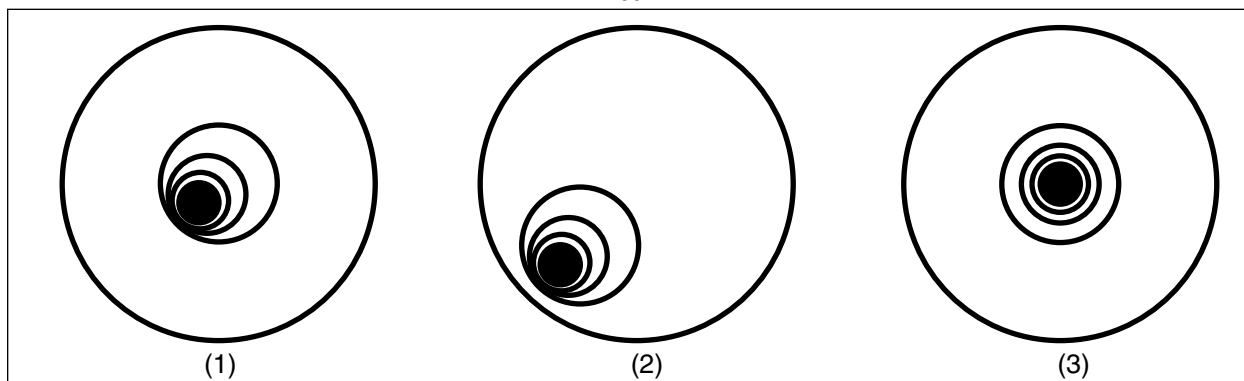


Fig. 27: De-focused Star Images.

- d. Turn the set screw that you found with the pointing exercise while looking in the eyepiece. You will notice that the star image will move across the field. If while turning, the out-of-focus star image flies out of the eyepiece field, then you are turning the screw the wrong way. Turn the opposite direction and bring the image to the center of the field.
- e. If while turning, you feel the screw get very loose, tighten the other two screws by even amounts. If while turning, the set screw gets too tight, unthread the other two by even amounts.
- f. When you bring the image to center (3, Fig. 27), carefully examine the evenness of the ring of light (concentricity). If you find that the dark center is still off in the same direction, continue to make the adjustment in the original turning direction. If it is now off in the opposite direction, you have turned too far and you need to turn in the opposite direction. Always double check the image in the center of the field of the eyepiece.
- g. You may find after your initial adjustment that the dark center is off in a new direction (*e.g.*, instead of side-to-side, it is off in an up-and-down direction). If this is the case follow steps b through f as described above to find the new adjustment screw.
- h. Now try a higher power (*e.g.*, 9mm or less) eyepiece and repeat the above tests. Any lack of collimation at this point will require only very slight adjustments of the 3 set screws. You now have a good collimation.
- i. As a final check on alignment, examine the star image in-focus with the higher power eyepiece as suggested above, under good seeing conditions (*e.g.*, steady atmospheric conditions). The star point should appear as a small central dot (the so-called "Airy disc") with a diffraction ring surrounding it. To give a final precision collimation, make extremely slight adjustments of the 3 set screws, if necessary, to center the Airy disc in the diffraction ring. You now have the best alignment of the optics possible.

3. Right Ascension Lock

After a period of time, it is possible that the R.A. lock (7, Fig. 1) of the LX200 will not tighten sufficiently due to internal wear of the clutch mechanism. In such an event, remove the R.A. lock lever using one of the hex wrenches supplied with the telescope. Then, with a pair of pliers, tighten the shaft protruding outward from the drive base until you cannot easily rotate the fork arm in R.A. (Take care in this operation not to damage the cosmetic finish of your LX200). Replace the R.A. lock lever so that the handle points straight out from the cross-bar connecting the fork arm.

4. Behind the Power Panel

The LX200 power panel houses the back-up replaceable battery (1, Fig. 28) for the clock and calendar and a replaceable

standard 1.0 amp slow-blow fuse (2, Fig. 28). The long-life lithium battery (Panasonic CR2032 3 vDC or Duracell DL2032B) is stored behind the front panel of the Drive Base. The battery does have to be changed every few years, and is done by unthreading the four phillips-head screws that secure the Front Panel to the Drive Base. Then with a thin flat-head screw driver, lift the small coin-size battery out of its holder. The new battery simply slides in place.

The 1.0 amp slow-blow fuse will sacrifice itself to protect the LX200 electronics in the event that the telescope is prevented from completing a GO TO function (*e.g.*, the tube runs into something that keeps it from slewing).

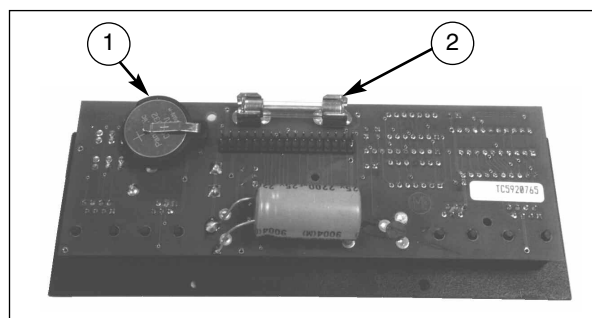


Fig. 28: Reverse Side of Power Panel. (1) Fuse; (2) Battery.

5. Factory Servicing and Repairs

Meade LX200 models have been designed and manufactured for years of trouble-free operation and repairs should rarely be necessary. If a problem does occur, first write or call our Customer Service Department. Do not return the telescope until you have communicated with us in this way, since the great majority of problems can be handled without the return of the telescope to us. However, should the occasion arise that the instrument requires factory servicing, a Meade Instruments Customer Service Representative will issue a Return Goods Authorization (RGA) number and give you full instructions on how to use it. Product returned without the RGA number may greatly delay any servicing or repairs. When telephoning or writing, please explain the exact nature of the problem so that we may offer a prompt remedial procedure. Be sure to include your full name, address, phone and fax numbers where you can be reached.

Should you live outside of the United States, contact your Authorized Meade Distributor.

You can reach the Meade Instruments Customer Service Department either by mail, phone, or fax at: Meade Instruments Corporation, 6001 Oak Canyon, Irvine, CA 92620-4205, telephone (949) 451-1450, or fax (949) 451-1460. Outside of the U.S.A., dial your International Access Code, then 1, then the ten digit number above in the 949 area code. Customer Service hours are 8:30 AM to 4:30 PM, Pacific Time, Monday through Friday.

APPENDIX F:

LX200 PERSONAL COMPUTER CONTROL

Remote operation of a computerized telescope has only been a fanciful dream for most amateur astronomers. The realization of fully controlling a telescope through a personal computer has previously been a staggering proposition involving high monetary cost and expert knowledge of software and hardware.

The LX200's internal software supports the RS-232 interface, requiring only a serial communication program such as Procomm. With a serial communication program, you can use the individual commands from the LX200 Command Set to simulate keypad control functions of the LX200. Every LX200 command and mode is available to explore the Object Library, to adjust slewing speeds, or to adjust focus with the optional #1206 Electric Focuser, just to name a few, with a simple RS-232 line connection to virtually any computer.

If you are not a professional programmer, but wish to explore remote operation of the LX200 with your computer, there are after-market software programs available specifically for the LX200, including AstroSearch from Meade Instruments Corp.

What follows is a schematic for constructing your own RS-232 cable, a program to test the RS-232 communication line called LX200 TEST, the LX200 Command Set, and LX200 DEMO, which is a program that you can enter into your computer to access the Object Library, slew to the object, and center the image.

1. RS-232 Cable

The input hardware uses a standard 6-line telephone jack connector, pre-attached to a 6-conductor flat line telephone style cable (of any length, up to 100' and perhaps even more, depending on the gauge of the cable). You will also need either a 9-pin or 25-pin RS-232 connector, whichever your computer uses for the serial port. All of the above items are available at most electronics hardware stores.

Fig. 29 shows the LX200 pinouts for the 6-line telephone connector. The table below shows standard IBM compatible DB-9 and DB-25 serial port pin outs,** and how they should be connected to the LX200 6-line modular connector.

NOTE: Only 3 wires are required.

2. LX200 Test Program

Once you have the RS-232 cable constructed you will want to test the cable. Below is a simple program called "LX200 TEST" that is written in GW Basic programming language and will work with virtually any IBM compatible computer. LX200 TEST is an effective program to fully check the RS-232 line communications from your personal computer to the LX200, allowing you to concentrate on de-bugging your RS-232 cable.

To enter the following program, first load BASIC or GWBASIC (whichever your computer system uses), then type in the following program. When complete, be sure to save the program as "LX200TST.BAS."

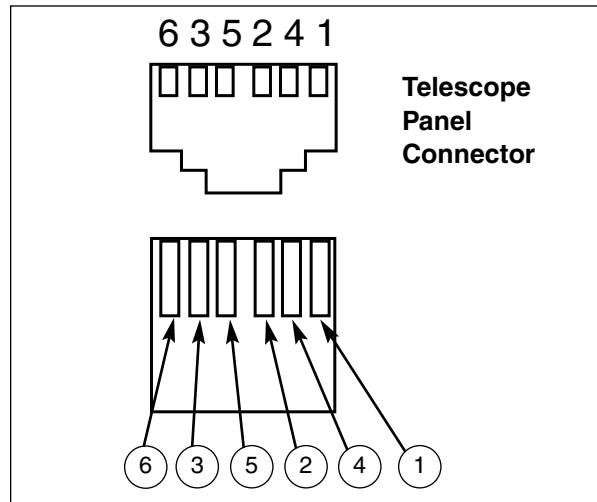


Fig. 29: LX200 Modular Connector.

```

10 CLS
20 DEFINT A-X
30 OPEN "COM1:9600,N,8,1,CD0,CS0,DS0,RS," FOR RANDOM
   AS #1
50 key1$ = INKEY$: IF key1$ = "" THEN GO TO 50
60 REM KEY1S
70 IF key1$ = CHR$(119) THEN GOSUB 200: REM "w" key
80 IF key1$ = CHR$(101) THEN GOSUB 200: REM "e" key
90 IF key1$ = CHR$(110) THEN GOSUB 200: REM "n" key
100 IF key1$ = CHR$(115) THEN GOSUB 200: REM "s" key
105 IF key1$ = "x" THEN END: REM To exit test.
110 GO TO 50
120 END
200 REM directions
210 REM west
220 IF key1$ = "w" THEN a$ = "#:Mw#": PRINT #1, a$: REM GO west
230 REM east
240 IF key1$ = "e" THEN a$ = "#:Me#": PRINT #1, a$: REM GO east
250 REM north
260 IF key1$ = "n" THEN a$ = "#:Mn#": PRINT #1, a$: REM GO north
270 REM south:
280 IF key1$ = "s" THEN a$ = "#:Ms#": PRINT #1, a$: REM GO south
290 key1$ = INKEY$:
300 IF key1$ = CHR$(32) THEN GO TO 400 ELSE GO TO 200
400 REM This stops motion (by hitting SPACE bar).
410 B$ = "#:Qe#": PRINT #1, B$
420 B$ = "#:Qw#": PRINT #1, B$
430 B$ = "#:Qn#": PRINT #1, B$
440 B$ = "#:Qs#": PRINT #1, B$
450 RETURN
460 END

```

To use the above program, connect the completed cable to your PC serial port and to the LX200 RS-232 Port. Load BASIC (or GWBASIC), if not already loaded, and run "LX200TST.BAS." Nothing will appear on the computer screen. Press any one of the N, S, E, or W (lower case) keys on your

LX200 RS-232 CONNECTOR PIN OUT CODE LEGEND			
6 WIRE MODULAR CONNECTOR	DESCRIPTION	TO DB-9 CONNECTOR PIN#***	TO DB-25 CONNECTOR PIN#***
#1	+12 VOLTS DC	NOT USED	NOT USED
#2	MISC. SERIAL OUT	NOT USED	NOT USED
#3	PC TRANSMIT DATA	#3	#2
#4	GROUND	#5	#7
#5	PC RECEIVE DATA	#2	#3
#6	MISC. SERIAL IN	NOT USED	NOT USED

PC keyboard, this will move the LX200 North, South, East, or West respectively. Press the space bar on the PC keyboard to stop. Press X to exit the program.

If the LX200 does not respond to the N, S, E, or W keys, be sure the CAPSLOCK is OFF. If it still does not work, check the PC serial port pinouts of your computer to be sure they are wired correctly to the LX200 6-line connector.

With a successful check-out of the PC link with the LX200 using LX200 TEST, you are now ready to write your own software program using the LX200 Command Set, or to use the sample program called "DEMO" that is written in Quick Basic software language.

3. LX200 Command Set

Intended for professional programmers, the LX200 Command Set is used to write custom software for remote operation of the telescope with a PC. Each command is listed in a section appropriate to its type. Each entry in the command list includes the command name, any parameters, any return values, and a description. The parameters and the return data are shown in a manner that indicates their format. These formats are listed below along with examples of how the data might actually appear, the legal range of values, and a short description. Below is a detailed description:

a. Command Set Formats

HH:MM.T

Example 05:47.4
Range 00:00.0 - 23:59.9
Hours, minutes, and tenths of minutes.

sDD*MM

Example +45*59
Range -90*00 - +90*00
Signed degrees and minutes (the "" represents ASCII 223 which appears on the handbox as a degree symbol).*

DDD*MM

Example 254*09
Range 000*00 - 359*59
Unsigned degrees and minutes.

HH:MM:SS

Example 13:15:36
Range 00:00:00 - 23:59:59
Hours, minutes, and seconds.

MM/DD/YY

Example 02/06/92
Range 01/01/00 - 12/31/99 (see description)
*Month, day, and year. The two digit year indicates the following:
92-99 = 1992-1999
00-91 = 2000-2091*

sHH

Example -5
Range -24 - +24
Signed hour offset.

NNNN

Example 3456
Range 0000 - 9999
Four digit object number.

sMM.M

Example 02.4
Range 05.5 - 20.0
Signed magnitude value.

NNN

Example 134
Range 000 - 200
Three digit object size (minutes).

DD*

Example 56*
Range 00* - 90*
"Higher" parameter (degrees).

TT.T

Example 59.2
Range 56.4 - 60.1
Tracking "frequency."

<obj> info

Example CNGC1976 SU DNEBMAG 3.9 SZ 66.0'
Range n/a
Object information.

Ok

Example 1
Range 0 or 1
Status value returned after setting values. If the value is legal 1 is returned, otherwise 0 is returned.

b. General Telescope Information

Command :GR#

Returns +HH:MM.T#
Gets the current Right Ascension.

Command :GD#

Returns sDD*MM#
Gets the current Declination.

Command :GA#

Returns sDD*MM#
Gets the current Altitude.

Command :GZ#

Returns DDD*MM#
Gets the current Azimuth.

Command :GS#

Returns HH:MM:SS#
Gets the current sidereal time.

Command :SS HH:MM:SS#

Returns Ok
Sets the sidereal time.

Command :GL#

:Ga#
Returns HH:MM:SS#
Gets the local time either in 24 hour (GL) or 12 hour (Ga) format.

Command :SL HH:MM:SS#

Returns Ok
Sets the local time. NOTE: The parameter should always be in 24 hour format.

Command :GC#

Returns MM/DD/YY#
Gets the calendar date.

Command :SC MM/DD/YY#

Returns Ok (see description)
Sets the calendar date. NOTE: After the Ok, if the date is valid, two strings will be sent. The first will contain the message "Updating planetary data," the second (sent after the planetary calculations) will contain only blanks. Both strings will be terminated by the "#" symbol.

Command :Gt#

Returns sDD*MM#
Gets the latitude of the currently selected site.

Command :St sDD*MM#

Returns Ok
Sets the latitude of the currently selected site.

Command :Gg#

Returns DDD*MM#
Gets the longitude of the currently selected site.

Command :Sg DDD*MM#
Returns Ok
Sets the longitude of the currently selected site.

Command :GG#
Returns sHH#
Gets the offset from Greenwich Mean Time.

Command :SG sHH#
Returns Ok
Sets the offset from Greenwich Mean Time.

Command :W1#
:W2#
:W3#
:W4#
Returns Nothing
Sets the current site number.

c. Telescope Motion

Command :Mn#
:Ms#
:Me#
:Mw#
Returns Nothing
Starts motion in the specified direction at the current rate.

Command :MS#
Returns 0, 1, 2, or 4 (see description)
Slows telescope to current object coordinates. 0 is returned if the telescope can complete the slew, 1 is returned if the object is below the horizon, 2 is returned if the object is below the "higher" limit, and 4 is returned if the object is above the lower limit. If 1, 2, or 4 is returned, a string containing an appropriate message is also returned.

Command :MA#
Returns 0
Slows telescope to object alt-az coordinates (set with the Sa and Sz commands). This command only works in the LAND and ALTaz modes.

Command :Qn#
:Qs#
:Qe#
:Qw#
Returns Nothing
Stops motion in the specified direction. Also stops the telescope if a slew to an object is in progress.

Command :Q#
Returns Nothing
Stops a slew to an object.

Command :RG#
:RC#
:RM#
:RS#
Returns Nothing
Sets the motion rate to guide (RG), center (RC), find (RM), or slew (RS).

Command :Sw N#
Returns Ok
Sets the maximum slew rate to "N" degrees per second where N is 2 through 4.

d. Home Position

Command :hS#
Returns Nothing
Starts a home position search and saves the telescope position. NOTE: All commands except ":Q#" and ":h?#" are disabled during the search.

Command :hF#
Returns Nothing
Starts a home position search and sets the telescope position according to the saved values. NOTE: All

commands except ":Q#" and ":h?#" are disabled during the search.

Command :hP#
Returns Nothing
Slows the telescope to the home position.

Command :h?#
Returns 0, 1, or 2
Returns the home status: 0 if home search failed or not yet attempted, 1 if home position found, or 2 if a home search is in progress.

e. Library/Objects

Command :Gr#
Returns HH:MM.T#
Gets object right ascension.

Command :Sr HH:MM.T#
Returns Ok
Sets object right ascension.

Command :Gd#
Returns sDD*MM#
Gets object declination.

Command :Sd sDD*MM#
Returns Ok
Sets object declination.

Command :Sa sDD*MM#
Returns Ok
Sets object altitude (for MA command).

Command :Sz DDD*MM#
Returns Ok
Sets object azimuth (for MA command).

Command :CM#
Returns (see description)
Sync. Matches current telescope coordinates to the object coordinates and sends a string indicating which object's coordinates were used.

Command :Gy#
Returns GPDCO#
Gets the "type" string for the FIND operation. A capital letter means that the corresponding type is selected while a lower case letter indicates it is not.

Command :Sy GPDCO#
Returns Ok
Sets the "type" string for the FIND operation.

Command :Gq#
Returns SU#, EX#, VG#, GD#, FR#, PR#, or VP#
Gets the current minimum quality for the FIND operation.

Command :Sq#
Returns Nothing
Steps to the next minimum quality for the FIND operation.

Command :Gh#
Returns DD*#
Gets the current "higher" limit.

Command :Sh DD#
Returns Ok
Sets the current "higher" limit.

Command :Go#
Returns DD*#
Gets the current "lower" limit.

Command :So DD*#
Returns Ok
Sets the current "lower" limit.

Command :Gb#
:Gf#
Returns sMM.M#

Gets the brighter (Gb) or fainter (Gf) magnitude limit for the FIND operation.

Command :Sb sMM.M#
:Sf sMM.M#

Returns Ok
Sets the brighter (Sb) or fainter (Sf) magnitude limit for the FIND operation.

Command :Gl#
:Gs#

Returns NNN'#
Gets the larger (Gl) or smaller (Gs) size limit for the FIND operation.

Command :SI NNN#
:Ss NNN#

Returns Ok
Sets the larger (SI) or smaller (Ss) size limit for the FIND operation.

Command :GF#
Returns NNN'#

Gets the field radius of the FIELD operation.

Command :SF NNN#
Returns Ok

Sets the field radius of the FIELD operation.

Command :LF#
Returns Nothing

Starts a FIND operation.

Command :LN#
Returns Nothing

Finds the next object in a FIND sequence.

Command :LB#
Returns Nothing

Finds the previous object in a FIND sequence.

Command :Lf#
Returns (see description)

Performs a FIELD operation returning a string containing the number of objects in the field and the object that is closest to the center of the field.

Command :LC NNNN#
:LM NNNN#
:LS NNNN#

Returns Nothing
Sets the object to the NGC (LC), Messier (LM), or Star (LS) specified by the number. Planets are "stars" 901-909. The object type returned for LC and LS commands depends on which object type has been selected with the Lo and Ls commands (see below).

Command :LI#
Returns <obj> info#

Gets the current object information.

Command :Lo N#
Returns Ok

Sets the NGC object library type. 0 is the NGC library, 1 is the IC library, and 2 is the UGC library. This operation is successful only if the user has a version of the software that includes the desired library.

Command :Ls N#
Returns Ok

Sets the STAR object library type. 0 is the STAR library, 1 is the SAO library, and 2 is the GCVS library. This operation is successful only if the user has a version of the software that includes the desired library.

f. Miscellaneous

Command :B+#
:B-#
:B0#

:B1#

:B2#

:B3#

Returns Nothing

Increases (B+) or decreases (B-) reticle brightness, or sets to one of the flashing modes (B0, B1, B2, or B3).

Command :F+#
:F-#
:FQ#
:FF#
:FS#

Returns Nothing

Starts focus out (F+), starts focus in (F-), stops focus change (FQ), sets focus fast (FF), or sets focus slow (FS).

Command :GM#
:GN#
:GO#
:GP#

Returns XYZ#

Gets SITE name (XYZ). M through N correspond to 1 through 4.

Command :SM XYZ#
:SN XYZ#
:SO XYZ#
:SP XYZ#

Returns Ok

Sets SITE name.

Command :GT#
Returns TT.T#

Gets the current track "frequency."

Command :ST TT.T#
Returns Ok

Sets the current track "frequency."

Command :TM#
:TQ#
:T+#
:T-#

Returns Nothing

Switch to manual (TM) or quartz (TQ). Increment (T+) or decrement (T-) manual frequency by one tenth.

Command :D#
Returns (see description)

Gets the distance "bars" string.

Command :AL#
:AP#
:AA#

Returns Nothing

Sets the telescopes alignment type to LAND, POLAR, or ALTAZ.

Command :r+#
:r-#

Returns Nothing

Turns the field de-rotator on (:r+#) and off (:r-#).

Command :f+#
:f-#

Returns Nothing

Turns the fan on (:f+#) and off (:f-#).

4. LX200 Demo Program

The RS-232 interface communicates with your computer at 9600 Baud Rate, Parity = None, 8 Data Bits, 1 Stop Bits. For those who are familiar with programming, the LX200 Command Set is written in ASCII character format and can be used to write your own programs.

The LX200 Demo Program on the following pages, is written in Quick Basic and is intended to demonstrate how commands are sent to the telescope and information is received from the telescope. It is not a "polished" program and does not incorporate all of the RS-232 features available.

The program is set-up to operate on serial port 2 (COM2:). To operate on serial port 1 (COM1:) line 4 should be changed from "COM2:" to "COM1:." The program is as follows:

CLS

DEFINT A-X

counter = 0

OPEN "COM2:9600,N,8,1,CD0,CS0,DS0,OP0,RS,TB2048,RB2048" FOR RANDOM AS #1

KEY ON

KEY(1) ON

KEY 1, "GO TO":

ON KEY(1) GOSUB key1

KEY(2) ON

KEY 2, "SYNC"

ON KEY(2) GOSUB KEY2

KEY(3) ON

KEY 3, "SLEW"

ON KEY(3) GOSUB key3

KEY(4) ON

KEY 4, "FIND"

ON KEY(4) GOSUB KEY4

KEY(5) ON

KEY 5, "CNTR"

ON KEY(5) GOSUB KEY5

KEY(6) ON

KEY 6, "GUIDE"

ON KEY(6) GOSUB KEY6

KEY(11) ON

ON KEY(11) GOSUB key11

KEY(12) ON

ON KEY(12) GOSUB key12

KEY(13) ON

ON KEY(13) GOSUB key13

KEY(14) ON

ON KEY(14) GOSUB key14

GOSUB status

GOSUB key3

GOSUB help

20 GOSUB telpos

GOSUB OBDRAW

GOSUB TIME

50 key\$ = INKEY\$: IF key\$ = "" THEN GO TO 20

Please note that Meade Instruments does not support these programs, or programs that you may write in any way. For questions relating to after-market software programs, refer back to those manufacturers.

Meade does recommend and support our Epoch 2000sk software package which is fully compatible with the LX200 telescope (Fig. 30). This program presents on the display of a personal computer an incredibly detailed simulation of the entire sky, including up to 281,000 celestial objects

Epoch 2000 allows the presentation of the most complex starfields just as they actually appear through the telescope. This software is available for Windows 3.1 or higher, including Windows 95.

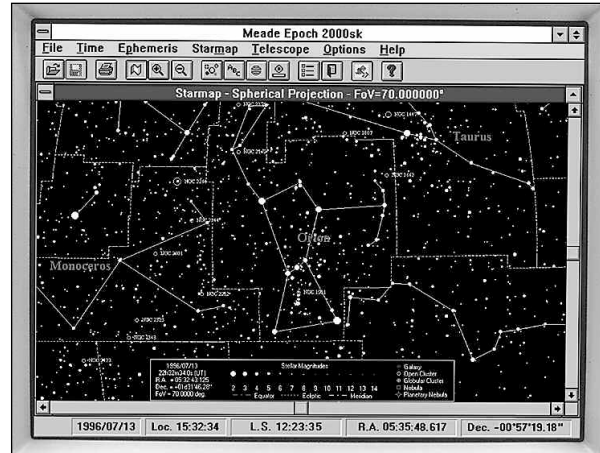


Fig. 30: Epoch 2000sk software.

REM KEYS

```
IF key$ = CHR$(119) THEN GOSUB senddir: REM a$ = "#:Mw#"
IF key$ = CHR$(101) THEN GOSUB senddir: REM a$ = "#:Me#"
IF key$ = CHR$(110) THEN GOSUB senddir: REM a$ = "#:Mn#"
IF key$ = CHR$(115) THEN GOSUB senddir: REM a$ = "#:Ms#"
IF key$ = "m" THEN GOSUB objects
IF key$ = "t" THEN GOSUB objects
IF key$ = "c" THEN GOSUB objects
IF key$ = "p" THEN GOSUB objects
IF key$ = "x" THEN CLS : END
IF key$ = "r" THEN RUN
```

GO TO 20

END

senddir:

west:

```
IF key$ = "w" THEN a$ = "#:Mw#": PRINT #1, a$: REM GO TO west
```

east:

```
IF key$ = "e" THEN a$ = "#:Me#": PRINT #1, a$: REM GO TO east
```

north:

```
IF key$ = "n" THEN a$ = "#:Mn#": PRINT #1, a$: REM GO TO north
```

south:

```
IF key$ = "s" THEN a$ = "#:Ms#": PRINT #1, a$: REM GO TO south
```

GOSUB telpos

key\$ = INKEY\$:

```
IF key$ = CHR$(32) THEN GO TO end1 ELSE GO TO senddir
```

end1:

```
B$ = "#:Qe#": PRINT #1, B$
```

```
B$ = "#:Qw#": PRINT #1, B$
```

```
B$ = "#:Qn#": PRINT #1, B$
```

```
B$ = "#:Qs#": PRINT #1, B$
```

RETURN

telpos:

```
LOCATE 6, 7: PRINT "TELESCOPE POSITION";
```

```
c$ = "#:GR#": PRINT #1, c$; : d$ = INPUT$(8, 1): RAL$ = LEFT$(d$, 3):
```

```
RAM$ = MID$(d$, 4, 4): LOCATE 7, 10: PRINT USING "RA : \\. \\"; RAL$; RAM$;
```

```
c$ = "#:GD#": PRINT #1, c$; : d$ = INPUT$(7, 1): RAL$ = LEFT$(d$, 3):
```

```
RAM$ = MID$(d$, 5, 2): LOCATE 8, 10: PRINT "DEC: "; RAL$; CHR$(248); RAM$; "";
```

```
c$ = "#:GA#": PRINT #1, c$; : d$ = INPUT$(7, 1): RAL$ = LEFT$(d$, 3):
```

```
RAM$ = MID$(d$, 5, 2): LOCATE 9, 10: PRINT "ALT: "; RAL$; CHR$(248); RAM$; "";
```

```
c$ = "#:GZ#": PRINT #1, c$; : d$ = INPUT$(7, 1): RAL$ = LEFT$(d$, 3):
```

```
RAM$ = MID$(d$, 5, 2): LOCATE 10, 10: PRINT "AZ : "; RAL$; CHR$(248); RAM$; "";
```

RETURN

TIME:

```
LOCATE 1, 32: PRINT "DATE"; : LOCATE 1, 64: PRINT "TIME";
```

```
c$ = "#:GS#": PRINT #1, c$; : d$ = INPUT$(9, 1): RAL$ = LEFT$(d$, 2):
```

```
RAM$ = MID$(d$, 4, 2): RAR$ = MID$(d$, 7, 2): LOCATE 2, 55:
```

```
PRINT USING "Sidereal Time: \\. \\. \\"; RAL$; RAM$; RAR$;
```

```
c$ = "#:GL#": PRINT #1, c$; : d$ = INPUT$(9, 1): RAL$ = LEFT$(d$, 2):
```

```
RAM$ = MID$(d$, 4, 2): RAR$ = MID$(d$, 7, 2): LOCATE 3, 55:
```

```
PRINT USING "Local (24hr) : \\. \\. \\"; RAL$; RAM$; RAR$;
```

```
c$ = "#:GG#": PRINT #1, c$; : d$ = INPUT$(4, 1): RAL$ = LEFT$(d$, 3):
```

```
LOCATE 3, 25: PRINT USING "GMT Offset: \ \ Hours"; RAL$;
```

```
c$ = "#:GC#": PRINT #1, c$; : d$ = INPUT$(9, 1): RAL$ = LEFT$(d$, 2):
```

```
RAM$ = MID$(d$, 4, 2): RAR$ = MID$(d$, 7, 2): LOCATE 2, 25:
```

```
PRINT USING "Date : \\. \\. \\"; RAL$; RAM$; RAR$;
```

RETURN

objects:

```
counter = 1
```

```
LOCATE 21, 25
```

```
IF key$ = "m" THEN INPUT "Enter Messier number: "; m$: o$ = "#:LM" + m$
```

```
IF key$ = "t" THEN INPUT "Enter Star number: "; m$: o$ = "#:LS" + m$
```

```
IF key$ = "c" THEN INPUT "Enter CNGC number: "; m$: o$ = "#:LC" + m$
```

```
IF key$ = "p" THEN INPUT "Enter Planet number: "; m$: o$ = "#:LP" + m$
```

```
o$ = o$ + "#"
```

```
PRINT #1, o$
```

```
LOCATE 21, 15:
```

```
PRINT "
```

```
,";
```

```
PRINT #1, "#:LI#": info$ = INPUT$(33, 1): REM LOCATE 10, 20: PRINT info$;
```

OBDRAW:

```

LOCATE 6, 31: PRINT "  O B J E C T  I N F O R M A T I O N";
LOCATE 7, 31: PRINT "Object:  "; LEFT$(info$, 9);
LOCATE 8, 31: PRINT "Rating:  "; MID$(info$, 10, 7);
LOCATE 9, 31: PRINT "Magnitude:  "; MID$(info$, 20, 5);
LOCATE 10, 31: PRINT "Size:      "; MID$(info$, 27, 6);
IF counter = 0 THEN LOCATE 11, 31: PRINT "RA:"; : LOCATE 12, 31:
PRINT "DEC:"; : LOCATE 7, 60: PRINT "Distance to SLEW"; :
LOCATE 9, 55: PRINT "RA"; : LOCATE 10, 55: PRINT "Dec"; : GO TO scale
c$ = "#:Gr#": PRINT #1, c$; : d$ = INPUT$(8, 1): RAL$ = LEFT$(d$, 2):
RAM$ = MID$(d$, 4, 4): LOCATE 11, 31:
PRINT USING "RA :    \ \ "; RAL$; RAM$;
c$ = "#:Gd#": PRINT #1, c$; : d$ = INPUT$(7, 1): RAL$ = LEFT$(d$, 3):
RAM$ = MID$(d$, 5, 2): LOCATE 12, 31:
PRINT "DEC:      "; RAL$; CHR$(248); RAM$; "";
distbar:
rad$ = "": decd$ = ""
c$ = "#:D#": PRINT #1, c$: d$ = INPUT$(33, 1)

FOR i = 1 TO 16
IF ASC(MID$(d$, i, 1)) = 255 THEN rad$ = rad$ + CHR$(254)
NEXT i
FOR i = 17 TO 33
IF ASC(MID$(d$, i, 1)) = 255 THEN decd$ = decd$ + CHR$(254)
NEXT i
LOCATE 7, 59: PRINT " Distance to SLEW  ";

scale:
LOCATE 8, 59: PRINT "0"; CHR$(248); " 45"; CHR$(248); " 90"; CHR$(248); " 150+";      CHR$(248);
IF counter = 0 THEN RETURN
LOCATE 9, 55: PRINT "          "; : LOCATE 9, 55:
PRINT "RA "; rad$;
LOCATE 10, 55: PRINT "          "; : LOCATE 10, 55:
PRINT "DEC "; decd$;
RETURN

status:
LOCATE 1, 7: PRINT "SITE"
c$ = "#:Gt#": PRINT #1, c$; : d$ = INPUT$(7, 1): RAL$ = LEFT$(d$, 3):
RAM$ = MID$(d$, 5, 2): LOCATE 2, 3: PRINT "Lat. : "; RAL$; CHR$(248); RAM$; "";
c$ = "#:Gg#": PRINT #1, c$; : d$ = INPUT$(7, 1): RAL$ = LEFT$(d$, 3):
RAM$ = MID$(d$, 5, 2): LOCATE 3, 3: PRINT "Long.: "; RAL$; CHR$(248); RAM$; "";
BOXSTX = 2: BOXSTY = 3: BOXWIDE = 10: boxtall = 5: GOSUB drawbox
RETURN

key1:
PRINT #1, "#:MS#"
error1$ = INPUT$(1, 1)
IF error1$ = "1" OR error1$ = "2" THEN error2$ = INPUT$(33, 1) ELSE RETURN
LOCATE 22, 20: PRINT error2$

GOSUB clearscr
RETURN

KEY2:
PRINT #1, "#:CM#"
sync$ = INPUT$(33, 1)
LOCATE 22, 20: PRINT sync$;

clearscr:
FOR i = 1 TO 30000: NEXT i: FOR i = 1 TO 30000: NEXT i: FOR i = 1 TO 30000: NEXT i:
FOR i = 1 TO 30000: NEXT i: FOR i = 1 TO 30000: NEXT i: FOR i = 1 TO 30000: NEXT i:
LOCATE 22, 20: PRINT "          ";

RETURN

key3:
PRINT #1, "#:RS#"
LOCATE 24, 1: PRINT "          ";
LOCATE 24, 18: PRINT CHR$(219); CHR$(178); CHR$(176); CHR$(176); CHR$(178); CHR$(219);

RETURN

KEY4:
PRINT #1, "#:RM#:"
LOCATE 24, 1: PRINT "          ";
LOCATE 24, 26: PRINT CHR$(219); CHR$(178); CHR$(176); CHR$(176); CHR$(178); CHR$(219);

RETURN

```

KEY5:

```
PRINT #1, "#:RC#"
LOCATE 24, 1: PRINT "
";
LOCATE 24, 34: PRINT CHR$(219); CHR$(178); CHR$(176); CHR$(176); CHR$(178); CHR$(219);
```

RETURN

KEY6:

```
PRINT #1, "#:RG#"
LOCATE 24, 1: PRINT "
";
LOCATE 24, 42: PRINT CHR$(219); CHR$(178); CHR$(176); CHR$(176); CHR$(178); CHR$(219);
```

RETURN

key11:

```
key$ = "n"
GOSUB north
RETURN
```

key12:

```
key$ = "w"
GOSUB west
```

RETURN

key13:

```
key$ = "e"
GOSUB east
RETURN
```

key14:

```
key$ = "s"
GOSUB south
```

RETURN

drawbox:

```
REM      LOCATE BOXSTX, BOXSTY:
REM      BOX$ = CHR$(201)
REM      FOR I = 1 TO BOXWIDE: BOX$ = BOX$ + CHR$(205): NEXT
REM      PRINT BOX$;
RETURN
```

help:

```
LOCATE 14, 10: PRINT "E W N S keys move telescope. SPACE BAR stops.";
LOCATE 15, 10: PRINT "M key to enter Messier object.";
LOCATE 16, 10: PRINT "T key to enter sTar.";
LOCATE 17, 10: PRINT "P key to enter Planet (900 + orbit #).";
LOCATE 18, 10: PRINT "C key to enter Cngc object.";
LOCATE 19, 10: PRINT "X to End program.";
```

RETURN

END

APPENDIX G: **LX200 SPECIFICATIONS**

Telescope	7" LX200 f/15	8" LX200 f/6.3	10" LX200 f/6.3
Optical Design	Maksutov-Cassegrain Catadioptric	Schmidt-Cassegrain Catadioptric	Schmidt-Cassegrain Catadioptric
Clear Aperture	178mm (7")	203mm (8")	254mm (10")
Primary Mirror Diameter	194mm (7.625")	209.6mm (8.25)	263.5mm (10.375)
Focal Length	2670mm (105")	1280mm (50.4")	1600mm (63")
Focal Ratio	f/15	f/6.3	f/6.3
Resolution	.64 arc sec.	.56 arc sec	.45 arc sec
Super Multi-Coatings	standard	Standard	Standard
Limiting Visual Magnitude (approx)	13.5	14.0	14.5
Limiting Photographic Magnitude (approx)	16.0	16.5	17.0
Image Scale (°/inch)	.55°/inch	1.14°/inch	0.91°/inch
Maximum Practical Visual Power	450X	500X	625X
Near Focus	50'	25'	50'
Optical Tube Size	9.1" Dia. x 19" Long	9.1" Dia. x 16" Long	11.75" Dia. x 22" Long
Secondary Mirror Obstruction	2.5" (12.8%)	3.45" (18.6%)	4.0" (16.0%)
Telescope Mounting	Heavy-Duty Fork-Type Double Tine	Heavy-Duty Fork-Type Double Tine	Heavy-Duty Fork-Type Double Tine
Setting Circle Diameters	Dec.: 6"; R.A.: 8.75"	Dec.: 6"; R.A.: 8.75"	Dec.: 6"; R.A.: 8.75"
RA Motor Drive System	9-speed, microprocessor controlled 12v. DC servo motor; 5.75" worm gear with Smart Drive	9-speed, microprocessor controlled 12v. DC servo motor; 5.75" worm gear with Smart Drive	9-speed, microprocessor controlled 12v. DC servo motor; 5.75" worm gear with Smart Drive
Hemispheres of Operation	North and South - switchable	North and South - switchable	North and South - switchable
Declination Control System	9-speed, DC servo controlled 5.75" worm gear with Dec drift software	9-speed, DC servo controlled 5.75" worm gear with Dec drift software	9-speed, DC servo controlled 5.75" worm gear with Dec drift software
Motor Drive Gear Diameter	5-3/4" Worm Gear	5-3/4" Worm Gear	5-3/4" Worm Gear
Manual Slow-Motion Controls	Dec. and R.A.	Dec. and R.A.	Dec. and R.A.
Hand Controller	Motorola 68HC05 microcontroller; 2 line x 16 alphanumeric character display; 19 button keypad, red LED backlit	Motorola 68HC05 microcontroller; 2 line x 16 alphanumeric character display; 19 button keypad, red LED backlit	Motorola 68HC05 microcontroller; 2 line x 16 alphanumeric character display; 19 button keypad, red LED backlit
Main Controller	16 MHz 68000 microprocessor; 1 Meg program memory 16K RAM; 512 byte non-volatile memory (EEROM)	16 MHz 68000 microprocessor; 1 Meg program memory 16K RAM; 512 byte non-volatile memory (EEROM)	16 MHz 68000 microprocessor; 1 Meg program memory 16K RAM; 512 byte non-volatile memory (EEROM)
Telescope Size, Swung Down	9.25" x 16" x 32.5"	9.25" x 16" x 25"	12" x 19" x 31"
35mm Angular Film Coverage	0.74° x 0.52°	1.55° x 1.08°	1.24° x 0.86°
35mm Linear Film Coverage @:			
50"	4.7" x 6.6"	9.7" x 13.6"	7.75" x 10.9"
500"	4.6' x 6.5'	9.4' x 13.3'	7.5' x 10.7'
3000"	27.4' x 38.9'	56.3' x 79.7'	45.0' x 63.8'
Tele-Extender Used Without Eyepiece @:			
50'	4.4" x 6.5"	9.1" x 13.3"	7.3" x 10.6"
500'	4.2' x 5.5'	7.7' x 14.1'	6.1' x 9.0'
3000'	24' x 34'	48' x 70'	39' x 56'
Net Telescope Weights (approx)			
Telescope	45#	37#	61#
Optional Equatorial Wedge	7#	7#	N/A
Optional Super Wedge	N/A	N/A	26#
Field Tripod	20#	20#	20#
Accessories	8#	8#	8#
Shipping Weights (approx)			
Telescope	65#	64# (w/ case)	69#
Equatorial Wedge (optional)	9#	9#	N/A
Super Wedge (optional)	N/A	N/A	38#
Field Tripod	26#	26#	26#
Case (for 10" models)		N/A	N/A
Accessories	5#	5#	5#

Telescope	8" LX200 f/10	10" LX200 f/10	12" LX200 f/10
Optical Design	Schmidt-Cassegrain Catadioptric	Schmidt-Cassegrain Catadioptric	Schmidt-Cassegrain Catadioptric
Clear Aperture	203mm (8")	254mm (10")	305mm (12")
Primary Mirror Diameter	209.6mm (8.25)	263.5mm (10.375)	314.3mm (12.375")
Focal Length	2000mm (80")	2500mm (100")	3048mm (120")
Focal Ratio	f/10	f/10	f/10
Resolution	.56 arc sec	.45 arc sec	.375 arc sec
Super Multi-Coatings	Standard	Standard	Standard
Limiting Visual Magnitude (approx)	14.0	14.5	15.0
Limiting Photographic Magnitude (approx)	16.5	17.0	17.5
Image Scale (°/inch)	0.72°/inch	0.57°/inch	0.48°/inch
Maximum Practical Visual Power	500X	625X	750X
Near Focus	25'	50'	75'
Optical Tube Size	9.1" Dia. x 16" Long	11.75" Dia. x 22" Long	13.6" Dia. x 25" Long
Secondary Mirror Obstruction	3.0" (14.1%)	3.7" (13.7%)	4.0" (11.1%)
Telescope Mounting	Heavy-Duty Fork-Type Double Tine	Heavy-Duty Fork-Type Double Tine	Heavy-Duty Fork-Type Double Tine
Setting Circle Diameters	Dec.: 6"; R.A.: 8.75"	Dec.: 6"; R.A.: 8.75"	Dec.: 6"; R.A.: 8.75"
RA Motor Drive System	9-speed, microprocessor controlled 12v. DC servo motor; 5.75" worm gear with Smart Drive	9-speed, microprocessor controlled 12v. DC servo motor; 5.75" worm gear with Smart Drive	9-Speed, microprocessor controlled 12v. DC servo motor; 5.75" worm gear with Smart Drive
Hemispheres of Operation	North and South - switchable	North and South - switchable	North and South - switchable
Declination Control System	9-speed, DC servo controlled 5.75" worm gear with Dec drift software	9-speed, DC servo controlled 5.75" worm gear with Dec drift software	9-speed, DC servo controlled 5.75" worm gear with Dec drift software
Motor Drive Gear Diameter	5-3/4" Worm Gear	5-3/4" Worm Gear	5-3/4" Worm Gear
Manual Slow-Motion Controls	Dec. and R.A.	Dec. and R.A.	Dec. and R.A.
Hand Controller	Motorola 68HC05 microcontroller; 2 line x 16 alphanumeric character display; 19 button keypad, red LED backlit	Motorola 68HC05 microcontroller; 2 line x 16 alphanumeric character display; 19 button keypad, red LED backlit	Motorola 68HC05 microcontroller; 2 line x 16 alphanumeric character display; 19 button keypad, red LED backlit
Main Controller	16 MHz 68000 microprocessor; 1 Meg program memory 16K RAM; 512 byte non-volatile memory (EEROM)	16 MHz 68000 microprocessor; 1 Meg program memory 16K RAM; 512 byte non-volatile memory (EEROM)	16 MHz 68000 microprocessor; 1 Meg program memory 16K RAM; 512 byte non-volatile memory (EEROM)
Telescope Size, Swung Down	9.25" x 16" x 25"	12" x 19" x 31"	15" x 20" x 37"
35mm Angular Film Coverage	0.97° x 0.68°	0.78° x 0.54°	0.65° x 0.45°
35mm Linear Film Coverage @:			
50"	6.2" x 8.7"	5.0" x 7.0"	4.1" x 5.8"
500"	6.0' x 8.5'	4.8' x 6.8'	4.0' x 5.7'
3000"	36.0' x 51.0'	28.8' x 40.8'	24.0' x 34.0'
Tele-Extender Used Without Eyepiece @:			
50'	6.8" x 8.5"	4.6" x 6.8"	3.5" x 5.7"
500'	4.9' x 7.2'	4.0' x 5.8'	3.3' x 4.8'
3000'	31' x 45'	25' x 36'	21' x 30'
Net Telescope Weights (approx)			
Telescope	37#	61#	70#
Optional Equatorial Wedge	7#	N/A	N/A
Optional Super Wedge	N/A	26#	26#
Field Tripod	20#	20#	50#
Accessories	8#	8#	8#
Shipping Weights (approx)			
Telescope	64# (w/ case)	69#	95# (w/ case)
Equatorial Wedge (optional)	9#	N/A	N/A
Super Wedge (optional)	N/A	38#	38#
Field Tripod	26#	26#	57#
Case (for 10" models)	30#	30#	N/A
Accessories	5#	5#	10#



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Every Meade telescope, spotting scope, and telescope accessory is warranted by Meade Instruments Corporation ("Meade") to be free of defects in materials and workmanship for a period of ONE YEAR from the date of original purchase in the U.S.A. and Canada. Meade will repair or replace a product, or part thereof, found by Meade to be defective, provided the defective part is returned to Meade, freight-prepaid, with proof of purchase. This warranty applies to the original purchaser only and is non-transferable. Meade products purchased outside North America are not included in this warranty, but are covered under separate warranties issued by Meade international distributors.

RGA Number Required: Prior to the return of any product or part, a Return Goods Authorization (RGA) number **must** be obtained from Meade by writing, or by calling (949) 451-1450. Each returned part or product must include a written statement detailing the nature of the claimed defect, as well as the owner's name, address, and phone number.

This warranty is not valid in cases where the product has been abused or mishandled, where unauthorized repairs have been attempted or performed, or where depreciation of the product is due to normal wear-and-tear. Meade specifically disclaims special, indirect, or consequential damages or lost profit which may result from a breach of this warranty. Any implied warranties which can not be disclaimed are hereby limited to a term of one year from the date of original retail purchase.

This warranty gives you specific rights. You may have other rights which vary from state to state.

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

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