Operating Instructions

Meade® MA 12mm Astrometric Eyepiece

Introduction: The Meade MA 12mm Astrometric Eyepiece (1.25" O.D.) functions as a multiple measuring device for determining angular diameters and position angles of celestial objects. It is also an excellent guiding eyepiece, used to monitor a guide star through an off-axis guider or guide telescope during long-exposure astrophotography.

The precision-etched glass reticle is illuminated by a continuously variable-brightness red LED (Light Emitting Diode), that can be dimmed to allow observations of very faint objects. The eyepiece can be focused to match the user's eye diopter so that the scales of the reticle can be examined in sharp focus.

Focusing the Eyepiece: To focus the reticle of the Astrometric Eyepiece, turn the Eyelens Focuser (1, Fig. 1) of the eyepiece clockwise or counterclockwise until the reticle scales are seen at their sharpest.

Using the LED Illuminator: To turn on the illuminator, rotate the illuminator control knob (3, Fig. 1) past the click stop. Illumination brightness control is varied by further turning the control knob. Turning clockwise increases the brightness of the LED, while counterclockwise decreases the brightness. To turn the illuminator off, turn the control knob all the way counterclockwise until it is turned to the click stop.

Astrometric Reticle Scales: There are 4 reticle scales etched into the glass reticle (Fig. 2) of the eyepiece that correspond to the table below:

Scale	Type	Description
1	Linear Diameter Scale	0 to 50 Units; Segmented in Single Units with Circular Center Position
2	Semicircular Position Angle Scale	0 to 90 Degrees with Circular Center Position
3	360° Position Angle Scale	Segmented in Units of 5°
4	Double Crossline/ Concentric Circle Guiding Scale	Four Concentric Circles with Each Inner Circle Representing .5 Width, .25 Width, and .10 Width of the Outer Circle Dimension, Bisected with a Double Crossline

Determining Image Scale: An accurate determination of the image scale for a given telescope can be accomplished by making visual timings of a star as it drifts through the Astrometric Eyepiece. To make the measurement follow these steps:

1. Set up the telescope and insert the Astrometric Eyepiece with the LED Illuminator turned on.
2. Check the collimation of the telescope (refer to the telescope's instruction manual). A collimated telescope produces the best image possible.
3. Bring the telescope to a sharp focus.
4. Aim the telescope at or very near (within +/- 5°) the zenith (perpendicular to the ground).
5. Turn off the telescope motor drive.
6. Rotate the Astrometric Eyepiece so that a star drifts along (*i.e.*, parallel to) the Linear Diameter Scale (1, Fig. 2) of the reticle.

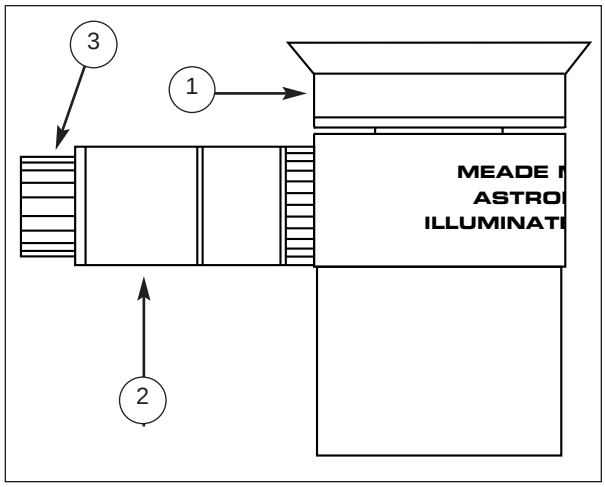

Fig. 1: MA 12mm Astrometric Eyepiece. (1) Eyelens Focuser; (2) Red LED Illuminator with Continuously Variable Brightness Control; (3) Brightness Control Knob.

7. Take three timings (in seconds) of a star as it crosses the Linear Diameter Scale. Begin the timing as the star crosses one edge of the scale and end the timing as the star crosses the other edge of the scale.
8. Record the timings and average them.

With the timings recorded and averaged, an accurate determination of the angular diameter of the sky that the Linear Diameter Scale represents can be calculated. Stars at or near the zenith move across the sky at 15 arc seconds per second (sidereal rate). To determine the true angular diameter in arc seconds, multiply the number of seconds of the averaged timing of the scale by 15. This number represents the entire length of the scale in arc seconds. To know the number of arc seconds represented by each of the segments of the scale, divide by 50. To know the value in arc minutes, divide arc seconds by 60. To know the value in degrees, divide arc seconds by 3600.

Example:

If the star takes 10 seconds to cross the entire length of the scale:

seconds X 15 = angular diameter in arc-seconds
10 X 15 = 150 arc-secs angular diameter

arc-secs ÷ 60 = angular diameter in arc-minutes
150 ÷ 60 = 2.5 arc-mins angular diameter

arc-secs ÷3600 = field of view in degrees
150 ÷3600 = 0.041° angular diameter

Use the above techniques and formulas for making measurements of any of the scales on the reticle of the Astrometric Eyepiece. Repeat these steps if the Eyepiece is used on a different setup (*e.g.*, used with a different diagonal, a Barlow lens, etc.).

Knowing the measurements of the scales of the reticle, the observer can take measurements to determine apparent diameters or angular separations of celestial objects (*e.g.*, planets, deep-sky objects, craters on the Moon, double stars, etc.). Other measurements can be made, such as the periodic error of the telescope's drive system.

Determining Position Angle: Position angle (PA) in astronomical terms is the direction in the sky of one celestial body with respect to another, measured from 0° to 360° in an easterly direction from north. Position angles are used by astronomers, for example, to give the position of a tail of a comet with respect to the nucleus of the comet, or to measure the position angle one component of a multiple star to another.

To make a position angle measurement, calibrate the orientation of the 360° Position Angle Scale (3, Fig. 2) along the east-west line of the sky by following these steps:

1. Set up the telescope and insert the Astrometric Eyepiece with the LED illuminator turned on.
2. Check the collimation of the telescope (refer to the telescope's instruction manual). A collimated telescope produces the best image possible.
3. Bring the telescope to a sharp focus.
4. Aim the telescope at or very near (within +/- 5°) the zenith (perpendicular to the ground).
5. Turn off the drive of the telescope.
6. Release the set-screw of the eyepiece holder and rotate the Astrometric Eyepiece within the eyepiece holder so that a star drifts across the 90° mark of the Position Angle Scale and then exits across the 270° mark.
7. Tighten the set-screw of the eyepiece holder to lock the position.

Once the scale is successfully calibrated along the east-west line of the sky, follow these steps to measure the position angle of a celestial object:

1. Place the reference object (*e.g.*, primary component of a comet nucleus) in the circular mark at the center of the Linear Diameter Scale (1, Fig 2.).
2. Find the object that the position angle is measured for (*e.g.*, discernable edge or center line of a comet's jet or tail that extends across the eyepiece field of view).
3. Read the position angle.

For example, if the nucleus of a comet is placed in the center of the Linear Diameter Scale, and the center of the tail (the object the PA measures for) is in-line with the first segment after 300 on the Position Angle Scale, then the PA of the center of the comet's tail is 305°.

Important Note: *The Position Angle Scale reads clockwise from 0° to 360° as used through mirror-lens Cassegrain telescopes (*e.g.*, Schmidt-Cassegrain, Maksutov-Cassegrain), or refractors where a diagonal mirror/prism is being used. If the Astrometric Eyepiece is being used without a diagonal prism or through a Newtonian reflecting telescope, the position angle reading should be reversed (*e.g.*, 90° translates to 270°).*

If the PA of a double-star, or other closely spaced objects is to be measured, use the Semicircular Position Angle Scale (2, Fig. 2). To make a measurement on this scale follow the same steps outlined above, but with these important differences:

- The Semicircular Position Angle Scale reads from 0° to 90° clockwise and counterclockwise. The clockwise direction is for measurements being made through mirror-lens Cassegrain telescopes (*e.g.*, Schmidt-Cassegrain, Maksutov-Cassegrain), or refractors where a diagonal mirror/prism is being used. Translate the 90° mark on the opposite side of the scale as 270°.
- The counterclockwise direction is for a Newtonian reflecting telescope or a telescope without a diagonal mirror/prism. In this case the 90° mark should be on the "left" side of the scale. Translate the 90° mark on the opposite side of the scale to 270°.

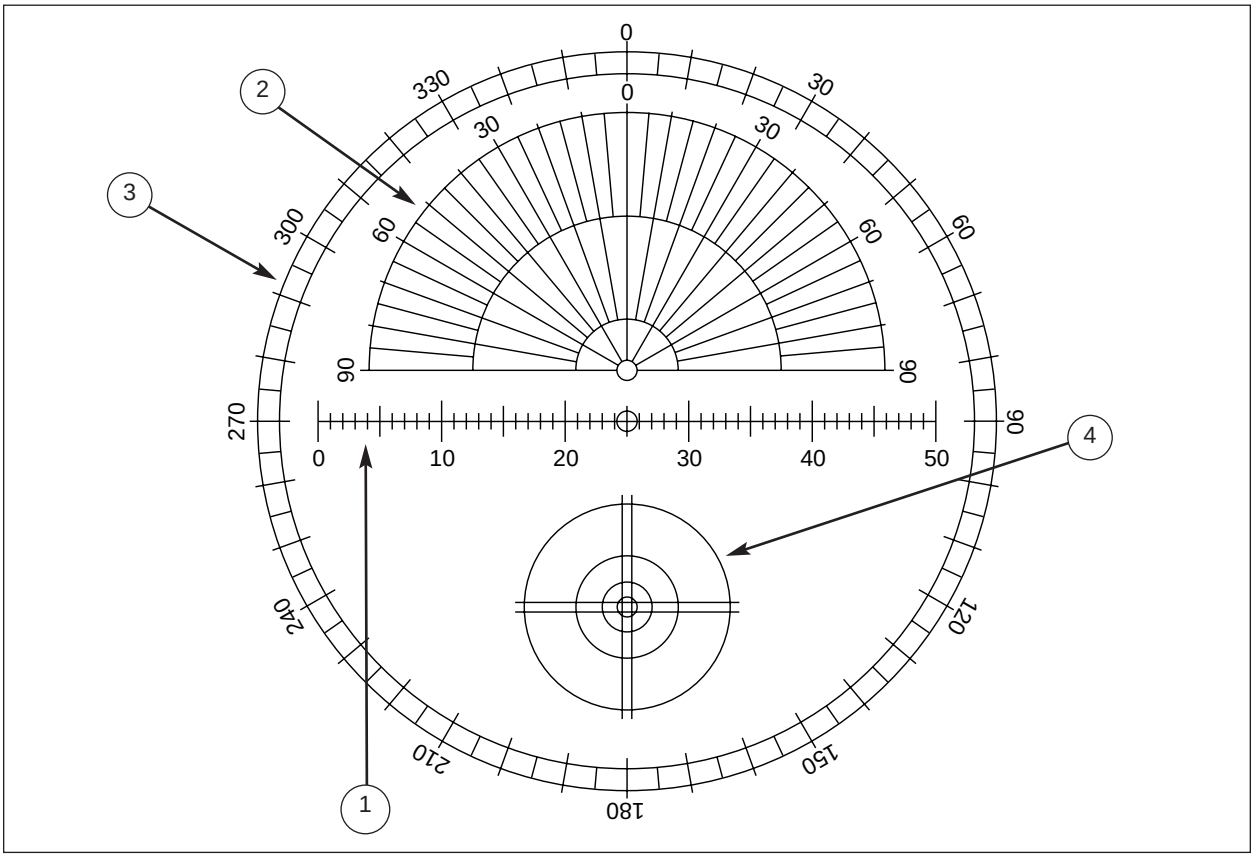

Fig. 2: MA 12mm Astrometric Eyepiece Reticle. (1) Linear Diameter Scale, (2) Semicircular Position Angle Scale; (3) 360° Position Angle Scale; (4) Double Crossline/Concentric Circle Guiding Scale.

If the object to be measured is “below” the east-west line, then the entire reticle must be rotated 180° to position the object within the Semicircular Position Angle Scale. Follow these steps:

1. Place a star on the 90° mark on the Position Angle Scale
2. Release the thumbscrew of the eyepiece holder and rotate the eyepiece until the same star is lined up on the 270° mark.
3. Tighten the thumbscrew to lock the eyepiece in position.zWith the Semicircular Position Angle Scale turned “upside-down” the scale markings should be translated as shown:

- The Semicircular Position Angle Scale reads from 0° to 90° clockwise and counterclockwise. The clockwise direction is for measurements being made through mirror-lens Cassegrain telescopes (*e.g.*, Schmidt-Cassegrain, Maksutov-Cassegrain), or refractors where a diagonal mirror/prism is being used. Translate the 0° mark as 180°. The 90° mark on the “right” side is correct, and the opposite side of the scale translates to 270°.
- The counterclockwise direction is for a Newtonian reflecting telescope or a telescope without a diagonal mirror/prism. Translate the 0° mark as 180°. The 90° mark on the “left” side is correct, and the opposite side of the scale translates to 270°.

Guiding the Telescope: The Double Crossline/Concentric Circle Guiding Scale (4, Fig. 2) is specifically designed for guiding on a star during an astrophotograph. The finest astrophotographs have sharply focused stars that are perfectly round. In order to achieve this level of quality in the final image, constant monitoring of a “guide star” is required to make the proper “drive corrections.”

The double crosslines and concentric circles of the Guiding Scale allow for a single star or group of stars to be guided on simultaneously. The eyepiece is normally used in an off-axis guider or guide telescope.

To determine the image scale in arc-seconds of the Guiding Scale, use the eight steps outlined in **Determining Image Scale**, with these important differences:

- Line up the star to be timed so that it runs parallel with one of the double crosslines.
- Start timing the star as it enters one edge of the large concentric circle.
- Finish timing the star as it leaves the other edge of the large concentric circle.

There are four concentric circles in the scale. Each is progressively smaller: the first circle’s diameter is half the size of the largest circle, then one fourth, and then one-tenth. After determining the image scale in arc-seconds of the largest circle, multiply by 0.5, 0.25, and 0.1 respectively to learn the image scale of the smaller concentric circles.

Maintenance: Avoid cleaning the eyepiece optics: a little dust on the surface of the eyepiece causes virtually no degradation of image quality and should not be considered reason to clean the lens. DO NOT disassemble the eyepiece to clean the interior lens surfaces or the reticle.

When absolutely necessary, dust should be removed with gentle strokes of a camel hair brush or blown off with an ear syringe (available at any pharmacy). DO NOT use a commercial photographic lens cleaner.

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

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

The LED Illuminator (3, Fig. 1) contains batteries that must be replaced occasionally. Use two (2) Duracell MS-76 photo batteries or equivalent. To open the illuminator, grab both ends of the illuminator and twist one end counterclockwise. Between battery replacements clean the battery contacts with the eraser-tip of a pencil.

If you have any questions regarding the use of the MA 12mm Astrometric Eyepiece, please call Meade Customer Service at (949) 451-1450. Customer Service hours are from 7:00 A.M. to 5:00 P.M. Pacific Time, Monday through Friday.

Battery Safety Instructions

- Always purchase the correct size (2 x 1.5V MS-76/LR44, SR1154, SR44 ANSI, LR6 IEC, SR1154 IEC) and grade of battery most suitable for the intended use.
- Replace all batteries of a set at the same time.
- Clean the battery contacts and also those of the device prior to battery installation.
- Ensure the batteries are installed correctly with regard to polarity (+ and -).
- Remove the batteries from any weather station which is not to be used for an extended period of time.
- Remove used batteries promptly.
- Do not mix old batteries with new batteries.
- Do not mix alkaline, lithium, standard (Carbon Zinc), or rechargeable (Nickel Cadmium) batteries.

Caution:

- If batteries or parts are swallowed, see a doctor immediately.

STANDARD WARRANTY INFORMATION

This product is warranted by Meade Instruments Corp. (MIC) to be free of defects in materials and workmanship for a period of ONE YEAR from date of original retail purchase in the U.S.A. MIC will repair or replace the product, or part thereof, found upon inspection by MIC to be defective, provided the defective part or product is returned to MIC, 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.

RGA Number Required: Prior to the return of any product or part, a Return Goods Authorization (RGA) number must be obtained by writing to Meade's Customer Service Department or by calling 800-626-3233. 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, phone number, and a copy of the original sales invoice.

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. MIC specifically disclaims special, indirect, or consequential damages or lost profits, which may result from a breach of this warranty. Any implied warranties which cannot be disclaimed are hereby limited to a term of one year from the date of purchase by the original retail purchaser. This warranty gives you specific rights. You may have other rights which vary from state to state.

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

This warranty supersedes all previous Meade product warranties.

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