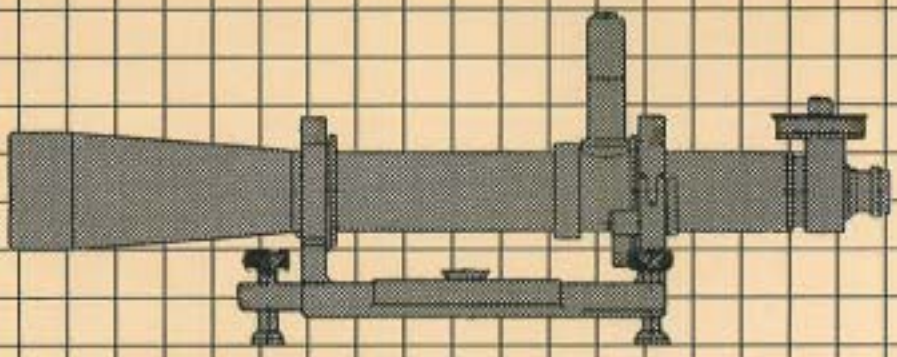
71 4210
VISUAL
AUTO-COLLIMATOR



INSTRUCTION MANUAL

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71 4210

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INTRODUCTION

Auto-collimation is a process of setting a mirror perpendicular to a telescopic line of sight. An eyepiece containing a semi-transparent mirror and a light, called an auto-collimation eyepiece, is used on the telescope. See Figure 1.

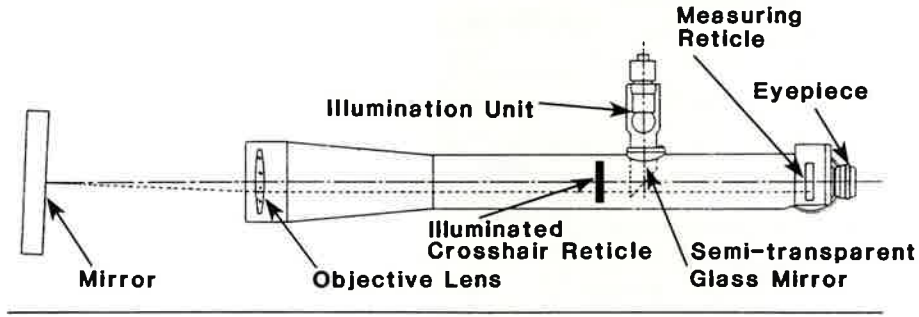

Figure 1. Schematic View Of Auto-Collimation

The semi-transparent glass allows the observer to see the reticle and at the same time serves as a mirror to reflect the light which illuminates the reticle. When the telescope is aimed at a mirror, the instrument serves as a telescopic sight and its image in the mirror serves as a collimator. When the observer has adjusted the leveling screws until both the actual reticle and its reflected image from the mirror are in the field of view of the eyepiece, he can measure the vertical or horizontal displacement. When the mirror is positioned so the reflected crosshairs coincide with the retical crosshairs, the mirror is perpendicular to the line of sight.

The 71 4210 K&E Visual Auto-Collimator is the basic unit for auto-collimation in the K&E product line. It can determine in fractions of seconds of arc the amount of deviation of the reflective surface about an axis perpendicular to the line of sight of the instrument. The collimator can be rotated through 90°, permitting measurements with the optical micrometer to be taken in either horizontal or vertical direction. Working range is not limited, because the measurement of deflection is independent of the distance between the auto-collimator and the reflective surface. A typical setup is shown in Figure 2.

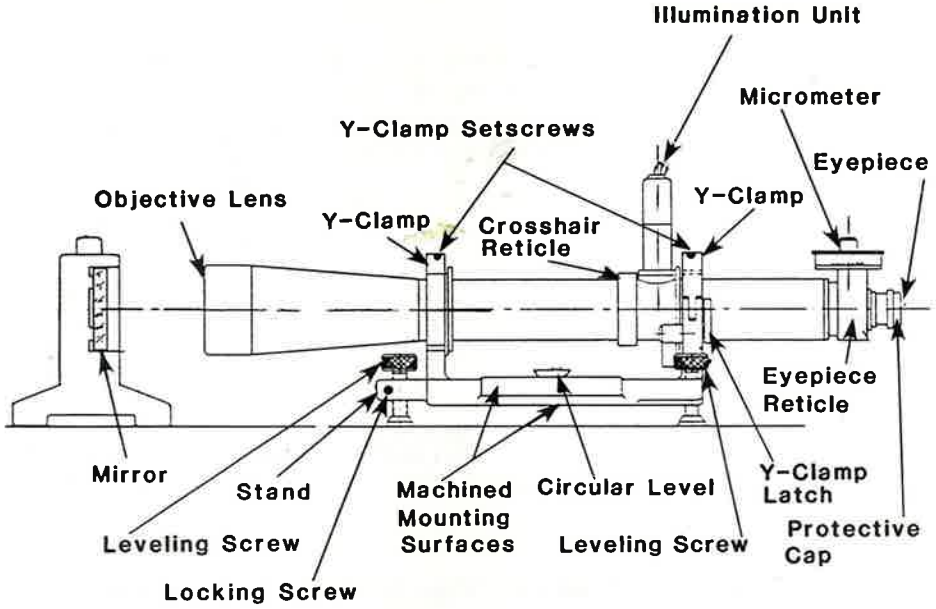

Figure 2. Auto-Collimator Setup

FEATURES

Micrometer

One division of the micrometer represents 0.2 seconds of arc in angular tilt of the reflective surface. If the auto-collimator is used to check alignment of a collimator or a fixed-focus telescope, the readings taken from the micrometer should be doubled to obtain the true angular reading. It rotates with the barrel of the instrument precisely 90° so that both vertical and horizontal displacement may be measured.

Y-Clamp

Two Y-clamps hold the barrel of the collimator firmly on the V-mounts so that it will remain level as long as the base is level.

Y-Clamp Setscrew

The setscrew in the top of each Y-clamp assures that the clamp is always in contact with the top of the barrel of the auto-collimator to hold it in place.

Y-Clamp Latch

Each Y-clamp is secured with a latch. The two latches should be completely in the lower position (against the lower latch stops) to securely lock the clamps. When the latches are in this position the instrument may be lifted or carried by its barrel. To remove the barrel from the stand, the latches must be completely against the upper latch stops.

Rotation Stop

An adjustable stop is located on each side of the bracket to limit the rotation of the instrument's barrel to precisely 90°.

Locking Screws

Each leveling screw, when adjusted, may be held in place by the tightening of its locking screw.

Machined Mounting Surface

The precision, machined surface is parallel to the line of sight for reference.

SETTING UP THE AUTO-COLLIMATOR

1. Set up the auto-collimator on a surface plate or on its flat, machined base, and align it to a mirror, as shown in Figure 2 above.

2. Adjust the three leveling screws until the return image from the mirror is in the field of view of the eyepiece and is slightly above or below the crosshair.

3. Tighten the three locking screws to keep the leveling screws in place.

NOTE

Where gravity reference is needed, initial leveling can be made with the circular level; however, usually it is more important to align the collimator to the mirror than to gravity. Even when gravity reference is being determined, setting the instrument to the level is an excellent first approximation, because in most applications the mirror will be vertical or nearly so.

FOCUSING THE EYEPIECE

Because the auto-collimator is a fixed-focus instrument, only one adjustment is necessary. The eyepiece must be focused clearly on the crosswire lines to bring both the direct and reflected image of the crosswire into sharp focus. To focus the eyepiece, proceed as follows:

1. Rotate eyepiece counterclockwise as far as it will go.

2. Then gradually rotate it clockwise until the crosshair reticle is in sharp and comfortable focus. The observer's eye should be relaxed, just as if looking at a far away object.

NOTE

Because the auto-collimator is a fixed-focus instrument, there is no possibililty of parallax error.

REFLECTIVE TARGETS

The K&E Auto-Collimator is designed to provide consistent and accurate results under sub-optimum conditions, although inevitably, some accuracy will be lost. For instance, occasionally, it may be necessary to work with a mirror which is small and which has a low percentage of reflectivity (such as the surface of a laser rod or gauge block), or it may be necessary to take separate auto-collimation images of two or more reflectors in the field of view at once.

The error incurred in these instances can be kept to a negligible amount if the center of the small reflector is positioned within the center of the optical axis and if the return image is of good resolution. Resolution is a composite of many factors: reflectivity, flatness and area of the test surface. Poor resolution will cause a wider dispersion or "scatter" of consecutive readings; however, this condition can be overcome by taking more readings so that the average value will still be quite reliable.

MEASURING VERTICAL DISPLACEMENT

1. Rotate the barrel of the instrument with the micrometer on top.

2. Turn the micrometer drum to bring the fine double-line fiducial (Figure 3) into the field of view.

3. Adjust until these wires precisely bracket the return image, as shown in Figure 4.

MEASURING HORIZONTAL DISPLACEMENT

Rotate the barrel of the instrument with the micrometer to the side and follow steps 2 and 3 above; the fine, double-line fiducial will be vertical when horizontal displacement is measured.

READING THE AUTO-COLLIMATOR

When the fiducial is centered on one of the lines of the reticle scale as in Figure 3, the micrometer drum will be at zero. One full revolution of the drum advances the fiducial to the next scale line. This corresponds to an angular increment of 30 seconds, as indicated by the numbers on the drum. Each long line on the reticle scale equals one minute of arc, and the numbers in the field of view show the 0, 5 and 10 minute positions.

The reading is the minutes and half minutes (shown on the comb in the view through the eyepiece) plus the seconds and tenths-of-seconds (shown on the micrometer drum).

For example, the fiducial in Figure 4 is slightly past the 3 1/2 minute mark. The micrometer drum at that time reads 13.4 seconds. (Remember that each of the small divisions equals 0.2 second). The sum of these values (3 minutes and 43.4 seconds) is the reading.

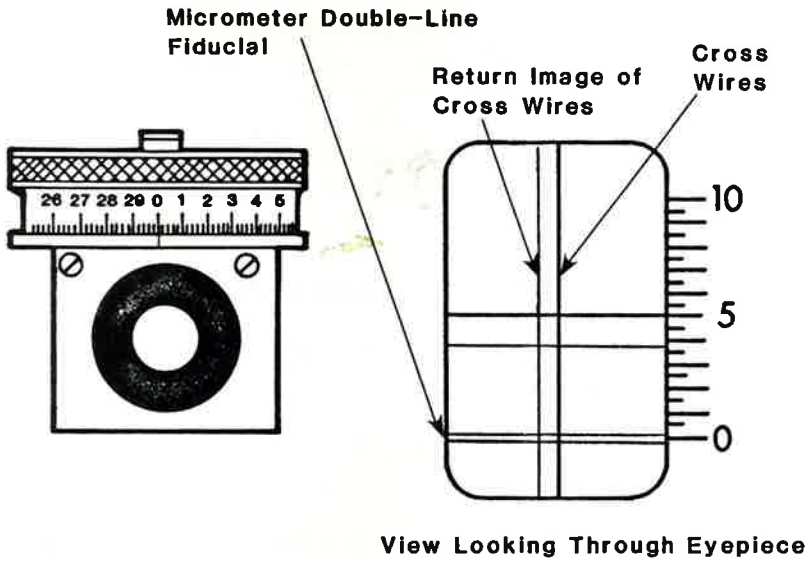

Figure 3. Micrometer Setting and View Through Eyepiece Before Centering Lines

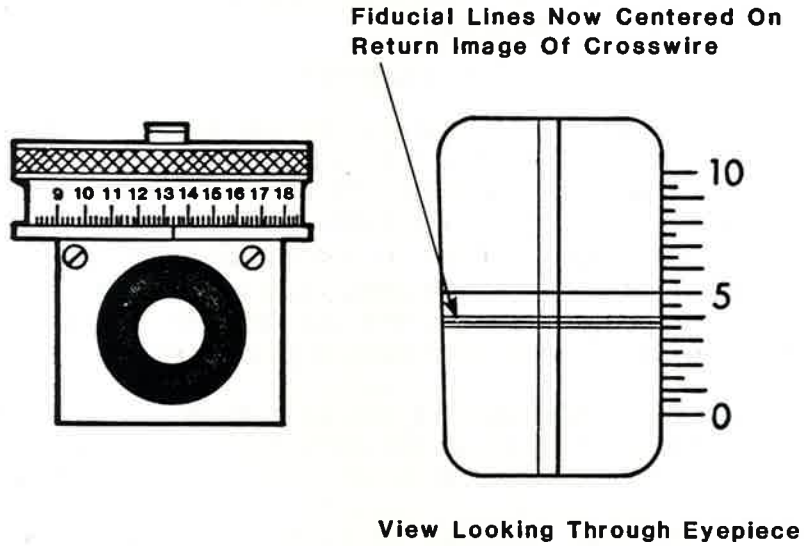

Figure 4. Micrometer Centering and View Through Eyepiece After Centering Lines

ACCESSORIES

Mirrors

Use of K&E mirrors is recommended. Refer to the Optical Alignment Equipment Catalog for descriptions of mirrors that can be used with the 71 4210 Visual Auto-Collimator. If other mirrors are used, they must optically flat and, preferably, should be front surface mirrors; and should be large enough to cover the full objective aperture.

Right-Angle Eyepiece

The 71 2230 K&E Right-Angle Eyepiece can be used in place of the standard eyepiece. With the right-angle eyepiece, it is possible to use the telescope at floor level or against a wall or other obstruction. The eyepiece can be rotated through 360° for sighting from any angle perpendicular to the line of sight. It maintains an erect image at any rotational orientation. To attach the right-angle eyepiece, refer to Figure 5 and proceed as follows:

1. Remove the protective cap from the micrometer eyepiece by holding the knurled ring stationary while unscrewing the cap in a counterclockwise direction.

2. Screw the adapter ring (which has two internal threads) on the exposed threads.

3. Screw the standard right-angle eyepiece into the adapter ring.

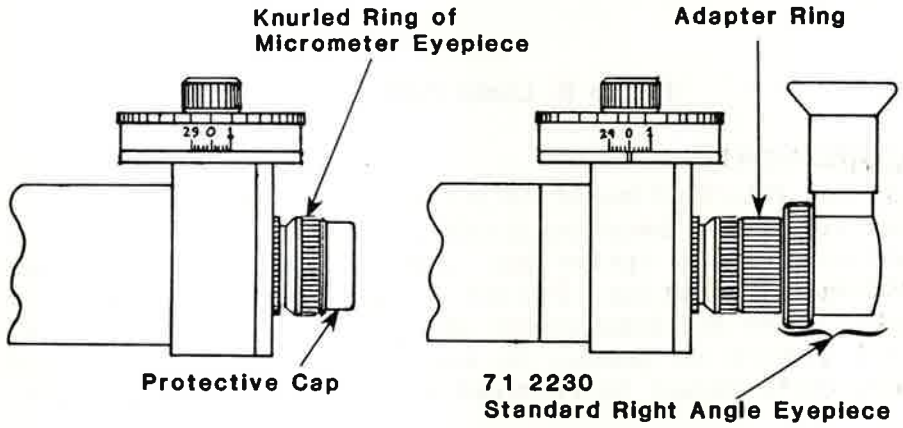

Figure 5. Right-Angle Eyepiece Attachment

MAINTENANCE

Ordinarily, the only maintenance procedure necessary is the occasional replacement of burned-out lamps. To replace the lamp, proceed as follows:

1. Pull apart the jack, as shown in Figure 6.

2. Unscrew the entire illumination unit from the auto-collimator, exposing the miniature lamp.

3. Remove the used lamp and replace it with a G.E. #50 6-volt miniature lamp or equivalent.

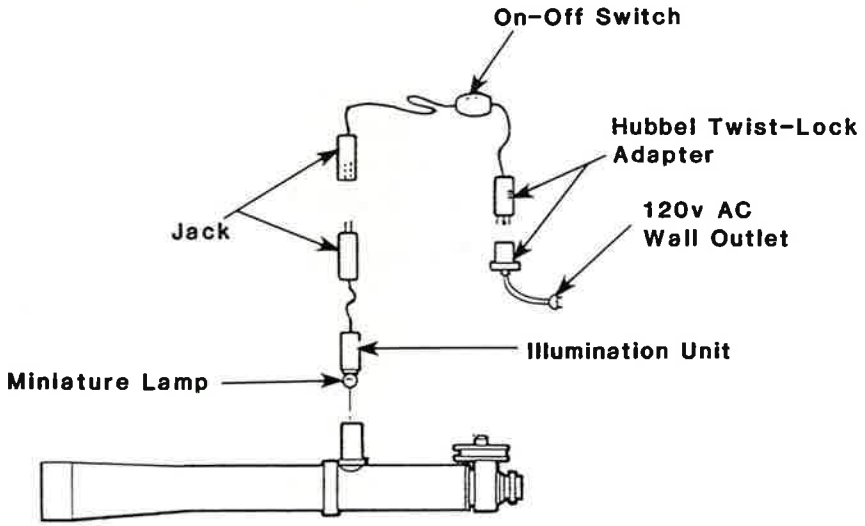

Figure 6. Lamp Replacement

ADJUSTMENTS

The K&E Auto-Collimator is a fixed-focus instrument, i.e. the focus has been laboratory set and sealed with the correct reticle centering, internal magnification and micrometer setting. Unless the instrument is tampered with, these settings cannot change, and attempts to do so will result in damage to sealed connections. A damaged instrument should be returned to the factory for repairs.

SPECIFICATIONS

Range: ±5 minutes of arc

Direct Reading: To .2 seconds of arc

Estimated Reading: To .1 seconds of arc

Working Distance: 0-50 feet with full micrometer
50-100 feet with ±2 minute range

Magnification: 53x

Field of View: 22 minutes of arc

Objective Aperture: 50 mm

Equivalent Focal Length: 900 mm

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