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6 pages  
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APPLICATION		REVISIONS			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVAL
141475 G1	9303.21A12	—	INITIAL RELEASE PER ER 46742	5/12/68	[Signature]
141444 G1	9303.21A12				


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 SC-14

OCT 04 1968  
 52371-106-1  
 AUG 14 1968

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OF SHEETS	SHEET	1	2	3	4	5	6													

UNLESS OTHERWISE SPECIFIED	CONTRACT NO.	 ITEK CORPORATION LEXINGTON, MASSACHUSETTS 02173		
TOLERANCES				
.00 ±	DRAWN K. J. Coughlin CHECKED [Signature] ISSUED [Signature] 3/13/68 PROJECT APP. [Signature]	OPTICAL ALIGNMENT PROCEDURE LOWER RHOMBOID ARM		
.000 ±				
ANGLES ±				
✓ FINISHED SURFACE ROUGHNESS	SIZE			CODE IDENT NO.
CENTERS PERMISSIBLE	A	92208	122433	
DIMENSIONS IN INCHES AND APPLY AFTER PROCESS	APPROVED	SCALE	REV —	SHEET / OF 6

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1.0 SCOPE

This procedure establishes the assembly/alignment sequence and details the adjustment accuracies for the interchangeable high power and low power, lower rhomboid arms 141475 and 141444.

2.0 DESCRIPTION

The two lower rhomboid arms are used interchangeably on the A-SVS, in order to vary input field coverage. Each arm contains two photographic lenses, a two element field lens, and two 1st surface mirrors. The arm units are to be aligned as modules so that they are fully interchangeable (optically and mechanically) between any of the rhomboid scanners which constitute the program. It should be noted that interchanging arms will upset the final systems error calibration so that the arms are not truly interchangeable.

3.0 SUMMARY

Alignment Procedure:

3.1 Concept

Standard optical tooling is combined with special fixturing to provide both the alignment required by the overall error budget detailed in memo 344-68-167 and the critical optical centering required to provide the specified image quality. In order to provide access to the lens adjustments, the lens fixture will support the lens so that it swings in a vertical plane, rather than the horizontal plane of the SVS. An adjustable steady rest will be used to set the arm horizontal and parallel to the base surface plate. The arm will be set by referencing from the keyway using a dial indicator.

The mirrors are assembled and their alignment to each other and to the lens axis is confirmed. The assembled lens mounts (without lenses) are test fitted and the flange reference surfaces checked for squareness to the optic axis. The rear (farther from the film) photographic lens is installed and adjusted using a collimator. The front lens is installed and both the

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centering and the focus are adjusted to a special target representing the film input. Module magnification is verified with a stage micrometer. The lenses are fine adjusted to obtain the best possible image from a pinhole. The optical performance is verified by substituting a resolution target. The field lens elements are installed and their focal shift and image centering are checked. The lower arm is then installed to the upper arm 141336 and final adjustments are made to the zoom collimator and the X-Y drive coupling per Rhomboid Alignment Procedures - 344-68-167.

3.2 Final Assembly Tolerances

- 3.2.1 The optical axes into and out of each arm shall be parallel within 10 arc minutes (i. e. the mirrors must be parallel within five arc minutes).
- 3.2.2 The optical axis, as defined by the coupling fixture shall be  $\pm 10$  arc minutes and coincide with the nominal height  $\pm .003$  (i. e. the optic must be parallel to the lens mount reference surface and keyway).
- 3.2.3 The rear lens shall be optically centered to the reference reticle  $\pm .003$ .
- 3.2.4 The front lens shall be centered so that center-center distance of rhomboid is maintained  $\pm .020$ .
- 3.2.5 All of the lower rhomboid arms (high and low power) shall have a common focus within a range of  $.003''$ .
- 3.2.6 The high power module shall have a magnification (without field lenses) of  $2.0/X \pm 2\%$ . The low power magnification shall be  $.885x \pm 3\%$ .

4.0 EQUIPMENT REQUIRED

- 4.1 Lower rhomboid arm alignment fixture 140375G1.
- 4.2 Alignment telescope, Taylor-Hobson 112/636/638
- 4.3 Bore fixture, Taylor-Hobson 112/646
- 4.4 Filar microscope, Gaertner M115A
- 4.5 Starrett level 199
- 4.6 Starrett inside micrometer 124B

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- 4.7 Starrett height gage number 254
- 4.8 Starrett dial test indicator number 711, or equivalent.
- 4.9 Collimator, Taylor-Hobson 112/782, on floor stand

5.0 DETAILED ALIGNMENT PROCEDURE

- 5.1 Set up the alignment fixture (140375G1) on any solid surface and level the base plate of the fixture. Use Starrett level number 199.
- 5.2 Mount the lower arm on its mating support flange and adjust the jacking screw to support the free end of the arm. The jacking screw should be adjusted until the keyway on the arm is parallel to the base plate. Use a height gage (Starrett number 254) and a dial test indicator (Starrett number 711) to adjust the arm keyway until it is parallel to the base plate within  $\pm .0005$  inch.
- 5.3 Install an alignment telescope in the bore fixture (Taylor-Hobson 112/646) and mount the bore fixture in the bore provided behind the reticle.
- 5.4 Align the telescope with the optical axis as established by the semi-reflecting reticle. Autocollimate from the semi-reflecting surface and use the tilt adjustments to position the telescope perpendicular to this surface. Use the lateral adjustment built into the system to translate the bore fixture until the telescope line of sight coincides with the reticle center.
- 5.5 Mount a mirrored target (K&E 716250) in the target stand assembly (140347G1) and align the target (and the target stand assembly) with the optical axis as established in 5.4. Lateral adjustments of the target may be made by tapping the target with a small mallet. Adjustments of angle with respect to a vertical plane through the optical axis may be made by adjustment of the guide bar which consists of a piece of ground flat stock. It will be necessary to maintain the target at a fixed distance from the flange of the reticle mount while it is being adjusted. This may be accomplished by obtaining an inside micrometer (Starrett number 124B). Use the necessary extension bars and set it to 10.043 inches. Use the instrument with this setting as a gage to maintain the proper distance between the face of the flange adjacent to the semi-reflecting reticle and the pad above the reticle aperture on the target.

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stand assembly.. Should it be necessary to tilt the target stand assembly to accomplish autocollimation from the target, tilting screws are built into the base. When the target and the guide bar have been properly aligned, clamp the guide bar in position.

- 5.6 Set the inside micrometer to 10.974 inches and while maintaining this setting, use it as a gage to adjust the set screw which serves as a stop for the target stand assembly. The target on the assembly must remain aligned with the telescope during this adjustment.
- 5.7 Install the elbow mirror and install the optical axis target assembly (141874G1) on the lens pad. Align the elbow mirror by autocollimation from the optical axis target. Tolerance for this alignment is  $\pm 1$  arc minute.
- 5.8 Remove the optical axis target. Slide the target stand assembly on the base plate to make contact with the set screw adjusted in step 5.6.
- 5.9 Install the wrist mirror on the rhomboid arm. Align this mirror by autocollimation from the target on the target stand assembly to  $\pm 2$  arc minutes.
- 5.10 If the high power arm is being aligned, remove it at this point and install the compensator assembly (140393G1). Replace the arm and check the target alignment.
- 5.11 Remove the target stand assembly. Mount a collimator on the floor stand and align it with the telescope line of sight.
- 5.12 Remove the telescope and the bore fixture as a unit and install the microscope (Gaertner M115A). Focus the microscope upon the optical axis reticle.
- 5.13 Install the lens closest to the elbow mirror. Adjust it to focus the collimator image at infinity upon the plane of the optical axis reticle. Center the lens to make the image center coincide with the reticle center.
  - 5.13.1 Low power arm only. Move the centered lens 0.614 inch toward the elbow mirror.
- 5.14 Install the second lens. Reinstall the target stand assembly. Adjust the lens to focus the target image upon the reticle plane.

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- 5.15 At this point magnification and resolution may be checked by substitution of the proper target on the target stand assembly. The point source image must be examined and the centering of both lenses corrected until a well defined, symmetric, airy disk is observed.
- 5.16 Remove the rhomboid arm and install the field lenses.
- 5.17 Remove the microscope and install the telescope and bore fixture. Check the alignment of the telescope with the optical axis reticle. Reinstall the K&E mirrored target in the target stand assembly, and realign it laterally. It will be necessary to use the inside micrometer set to 10.974 inches as a gage as in step 5.6 to complete this realignment.
- 5.18 Remove the reticle target. Install the rhomboid arm.
- 5.19 Check the centering of the stage target image with the telescope. The stage target should be moved to contact its stop for this check.
- 5.20 If the focus of the arm has been disturbed by the installation of the field lens, it may be adjusted after the lower arm has been joined to the upper arm by observing the image registration with the reticle above the shoulder bearing.

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