

Interoffice

National Radio Astronomy Observatory

Charlottesville, Virginia

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12 METER MILLIMETER WAVE TELESCOPE  
MEMO No. 111

Subject: A close look at the first set of ESSCO plate measurements

We received the first set of data on plate no. 1946-A01 (memo 104). The measurement was made on their own measuring machine with the plate placed to a specific reference position (memo 82). Based on this information I did the following computations:

	Deviation in mm rms	Condition
1. ESSCO measurement with plate positioned to a measuring machine	0.041	none
2. Established a mean surface *	0.036	Suggested to make adjustments on all target points by the amount of +0.020 mm.
3. A three-degree-of-freedom best fitting: rotation in two axes and a dz adj.	0.031	Suggested to make adjustments on all target points shown in next table.
4. A four-degree-of-freedom best fitting: rotation in two axes, dz and focal length adj.	0.030	Same as above, but with focal adj. of +0.455 mm.

\* ESSCO used this conclusion.

Figures 1 through 4 show the shape on each computation. Only the concave areas are shaded (causing longer path length) for clarity. The contour level is at every .001 inch.

The adjustments needed on each computation are tabulated with the target coordinates given in inches, and adjustments in mm.

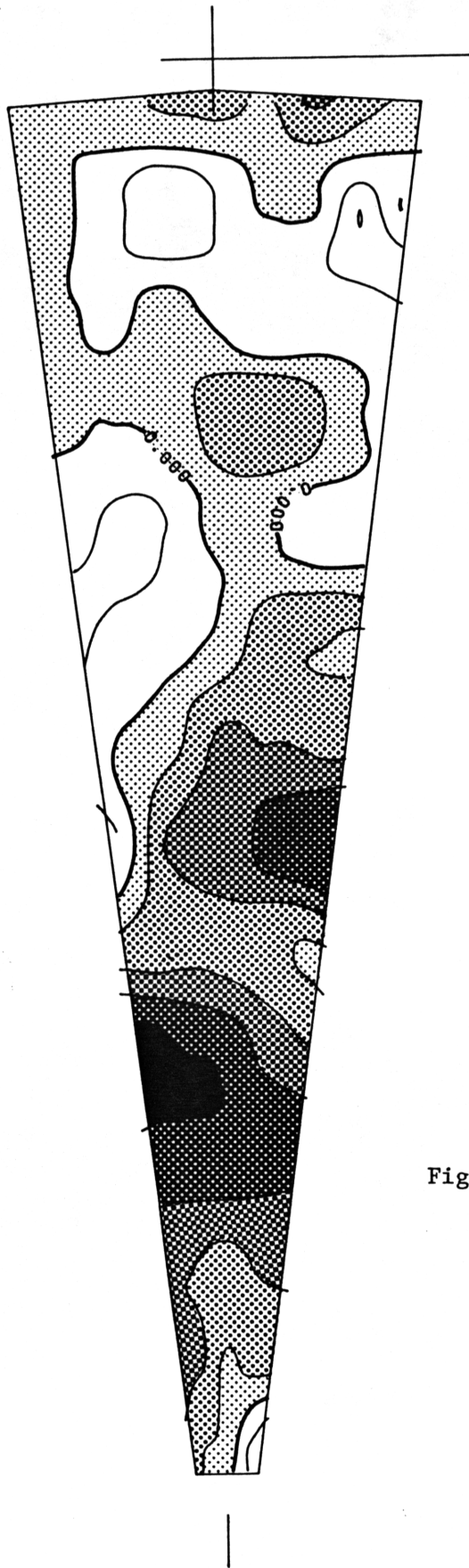
(continued on page 2)

Target coordinates  
in inches

		adjustments in mm			
		Step 1	Step 2	Step 3	Step 4
1.	135.081 1.375			.058	.043
2.	88.972 7.432			.041	.053
3.	47.022 12.814		0.020	.085	.051
4.	6.058 17.960	none	all	.010	.041
5.	135.081 -1.375			.056	.041
6.	88.972 -7.432			.033	.046
7.	47.022 -12.814			.010	.038
8.	6.088 -17.960			-.010	.023

Note that the value of surface error decreases as the degree-of-freedom in best fitting increases. Step no. 1 shows a combination of setting and fabricating errors, whereas step no. 3 shows the fabricating error alone (assuming the measuring error is small and insignificant). It might be safe to say that ESSCO had produced at least one .030 mm plate. It would be interesting to see if their performance is consistent.

On the other hand, it is not entirely clear to what extent the individual plate support affects the surface shape. All computations are based on the rigid body motion of the plate. It might be possible that a different setting on any single support would render a different contour and make it possible to improve the plate by tuning the adjustment screws on "bad" areas only.



+Y

MEASURED SHAPE .041 MM

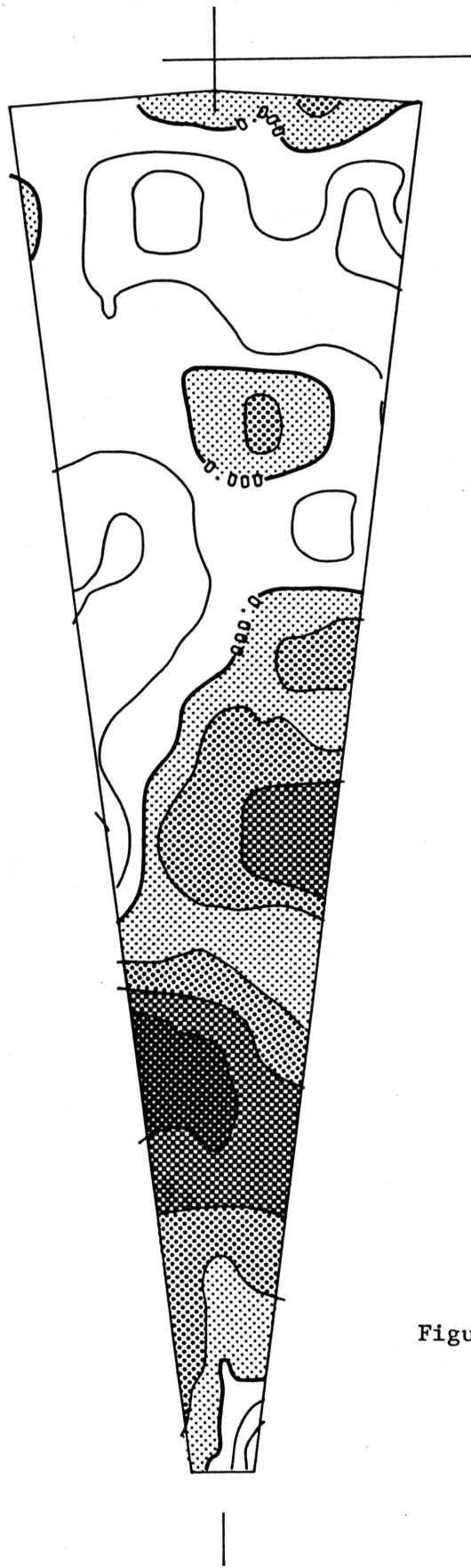
CONTOUR = .001 IN.

- : SHORTER PATHLENGTH

+ : LONGER PATHLENGTH

Figure 1. ESSCO measurement with plate positioned to their measuring machine.

X+



+Y

ERROR .036 MM RMS

DZ .020 MM

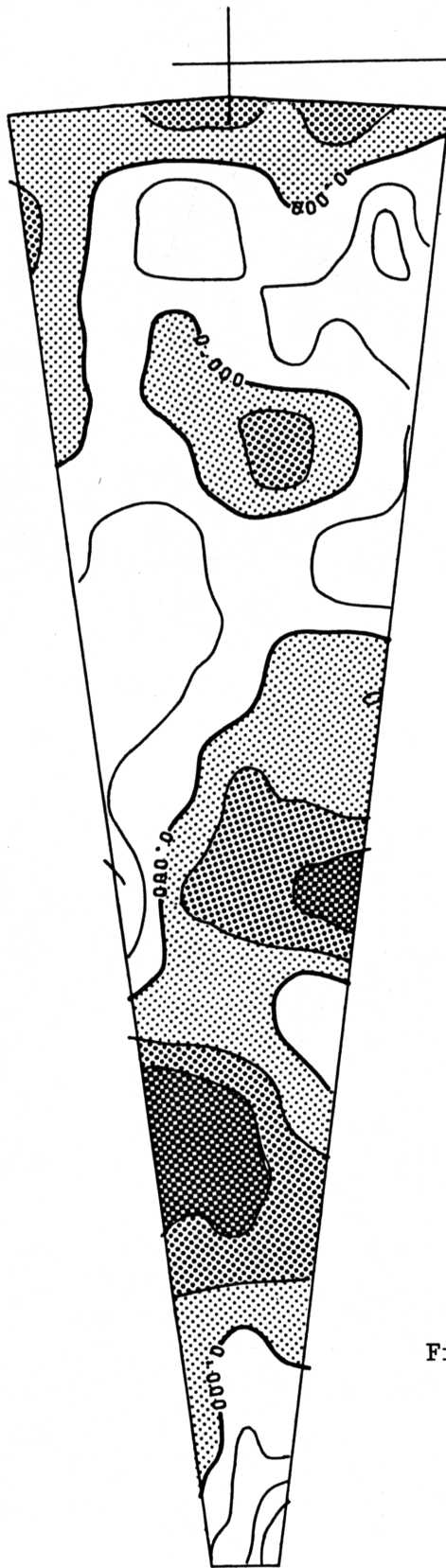
CONTOUR AT .001 IN

- : SHORTEN PATHLENGTH

+ : LONGER PATHLENGTH

Figure 2. Deviation from a mean surface.

X+



+Y

ERROR .031 MM RMS

DZ -0.003 MM

RX +2.2 E-5 RAD

RY +1.8 E-5 RAD

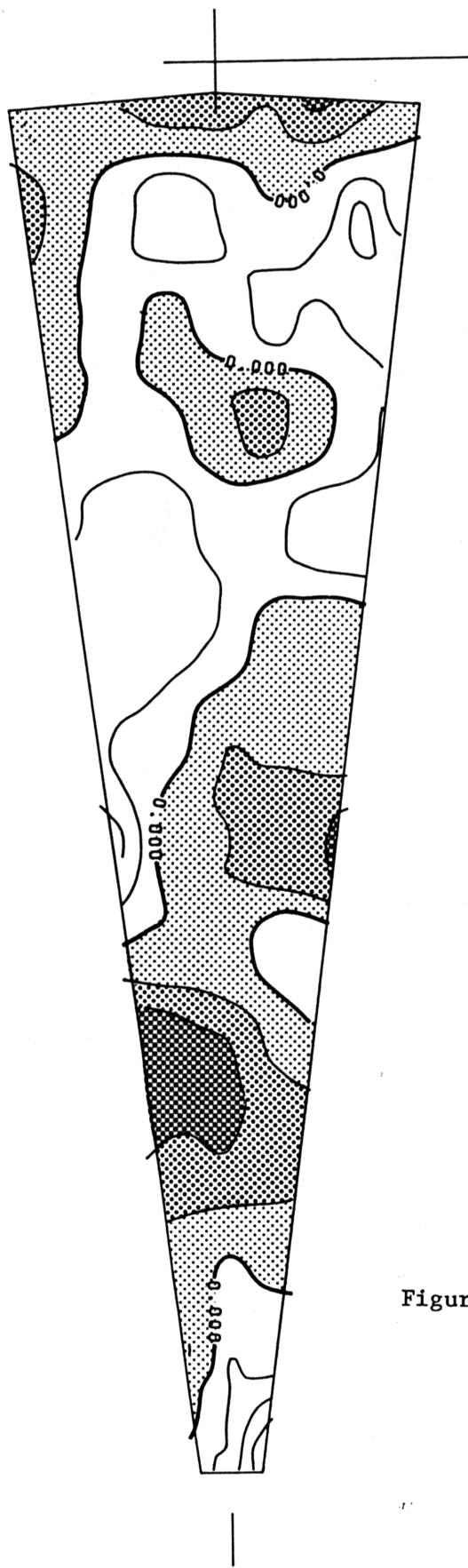
CONTOUR AT .001 IN

- : SHORTEN PATHLENGTH

+ : LONGER PATHLENGTH

Figure 3. A three-degree-of-freedom best fitting: rotations in X- and Y-axes plus a dz adjustment.

X+



ERROR .030 MM RMS  
 DZ .046 MM  
 RX +2.1 E-5 RAD  
 RY +0.3 E-5 RAD  
 DF +0.455 MM  
 CONTOUR AT .001 IN  
 - : SHORTEN PATHLENGTH  
 + : LONGER PATHLENGTH

Figure 4. A four-degree-of-freedom best fitting: rotations in X- and Y-axes, dz and focal length adjustments.

X+