Interoffice

National Radio Astronomy Observatory

Charlottesville, Virginia

August 13, 1974

25-METER - MILLIMETER WAVE TELESCOPE
MEMO # 8

To: 25^m mm Wavelength Telescope Design Group

From: W.-Y. Wong

Subject: Measurements on surface plates #1 and #2 of 65^m homology telescope

These two plates were manufactured by Philco-Ford and were delivered to us in December of 1972. The specifications state that 1) manufacturing tolerance should be less than 2.5 mil rms, and 2) gravitational deformation should be less than 2.0 mil rms. Measurements were made by Philco-Ford prior to the delivery. Measurements were verified by S. Smith on February, 1973. The total surface error, a combination of manufacturing tolerance and dead weight deformation is 2.5 mil rms for the #1 plate, and 1.3 mil rms for the #2 plate.

Plate #1 was painted white. It was stress released by temperature cycles during manufacturing. It was stored in a wooden box in Green Bank warehouse and was handled with care.

Plate #2 was not painted. It was not stress released. It was stored in a barn in Green Bank and was not handled with care. Visible scratches were found on the surface.

Other than those differences, these two plates are identical in overall dimensions, (approx. 74" x 28"), material, (A356-T51), and manufacturing method, (cast and mill by 3-axes N/C machine).

In July, 1974, J. Ralston, S. Smith and I made another set of measurements on these two plates. The reasons for the measurements are:

1) To find if there is any change of surface error on plate #1 in the course of 17 months.

2) Plate #2 had been sent to Rohr in December, 1973 for an independent check. They have a machine called Portage Dimension Qualifier, model 350, which has a resolution of 0.1 mil rms. Their result on plate #2 is 3.0 mil rms, meaning the surface error of plate #2 had degenerated more than 100%.

Table I summarizes the results of the measurements:

	Philco-Ford Dec. 1972	S. Smith Feb. 1973	Rohr Dec. 1973	W. Wong July 1974	Remarks
Plate #1 S.P.R.	---	---	---	---	No measurements with respect to S.P.R.
Plate #1 H.P.R.	2.5	2.5	---	2.4	Figure 1
Plate #2 S.P.R	---	---	3.0	3.0	Figure 3
Plate #2 H.P.R.	1.3	1.3	---	2.0	Figure 2

Table I. Comparison of Various Measurements in rms $(\Delta-\bar{\Delta})$ x 10^{-3} inch

S.P.R. - Soft Point Reference. Reference points were chosen on the 4 extreme corners of the plate, which do not have high structural stiffness. These points are cantilever from the structural rib 1-1/2" in one direction, and 2-1/4" in the other (see Figure 4). Any permanent deformation on these areas due to mis-handling of the plate will result in erroneous measurements.

H.P.R. - Hard Point Reference. Reference points were chosen on the surface above the structural ribs (see Figure 4) where structural stiffness is high.

Conclusions:

1) For future measurements, only H.P.R. is recommended.
2) Flange should be reduced from 2-1/4" to about 1/2". This enables the adjustment mechanism to attach to the bottom of the rib instead of directly to the skin.
3) Plates are to be handled with care.
4) No creep is found if the plate is temperature cycled. The result of measurement on plate #1 shows no change for 17 months.
5) A plate with a surface error of 1.3 mil rms seems possible by the industry. Note that we did not specify that kind of accuracy.

Recommendations:

We should ask the industry to manufacture two more test plates, with the specification of:

a) manufacturing tolerance; rms $(\Delta-\bar{\Delta})$ = 1.4 mil
b) gravitational deformation 0.8 mil rms
c) size of plate reduced to 55" x 29 " approx.
d) thermal deformation = 1.4 mil rms if the skin is 1 °F higher than the lower parts of the rib.

These specifications were met with S. Von Hoerner's plate with 36 adjustment screws.

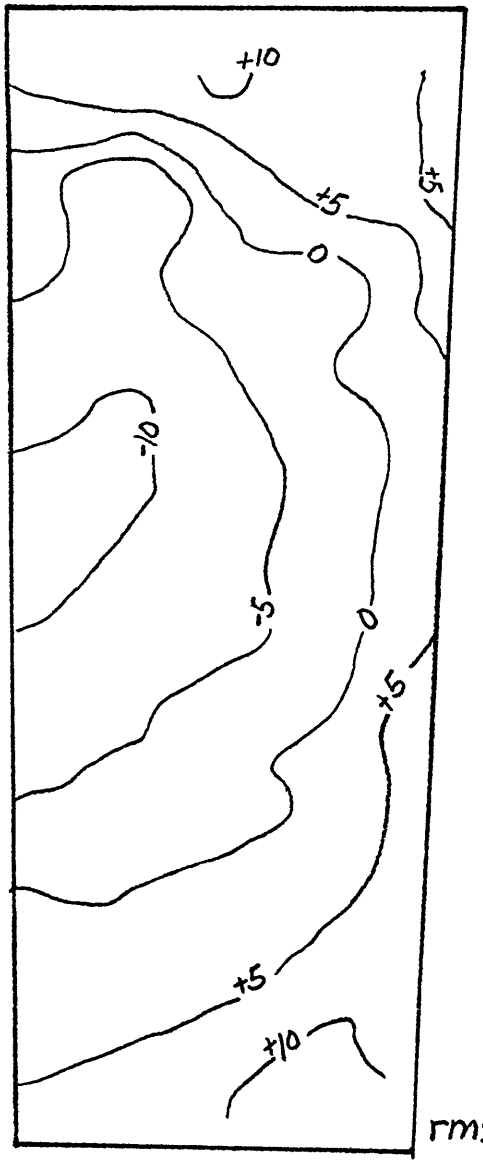
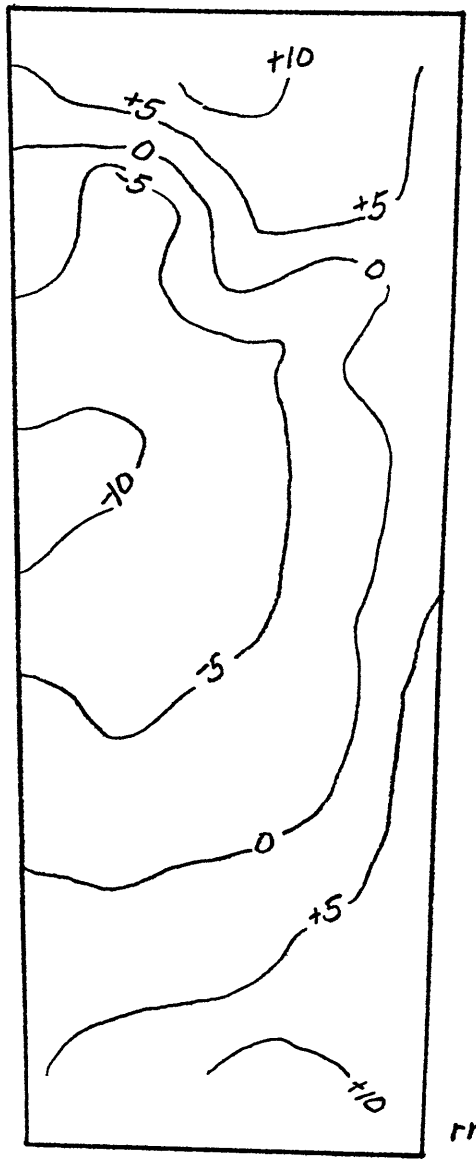


Plate #1
H.P.R.

Contour in
$mm \times 10^{-2}$

$rms(\Delta - \bar{\Delta})$
$= 2.5 \times 10^{-3}$ in.

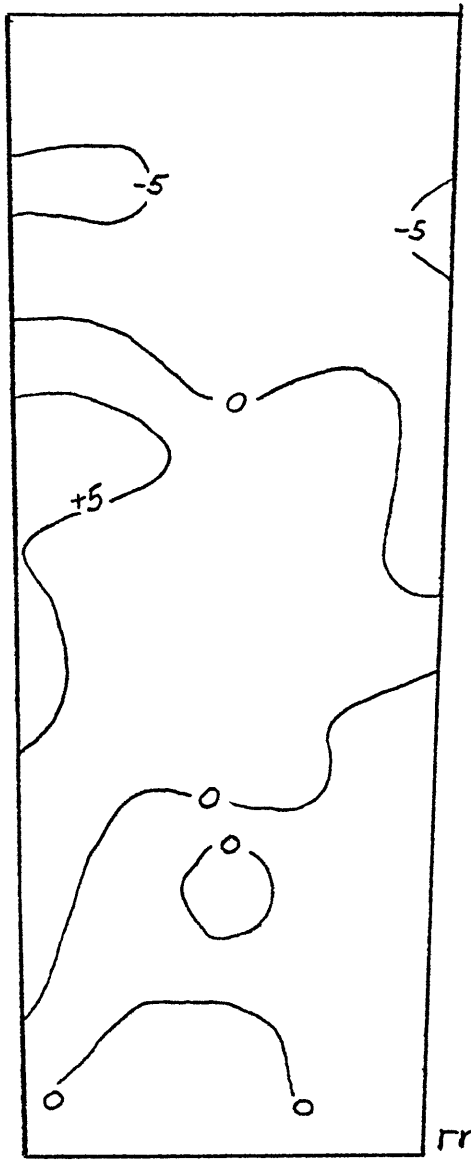
S. Smith



$rms(\Delta - \bar{\Delta})$
$= 2.4 \times 10^{-3}$ in.

W. Wong

FIG. 1

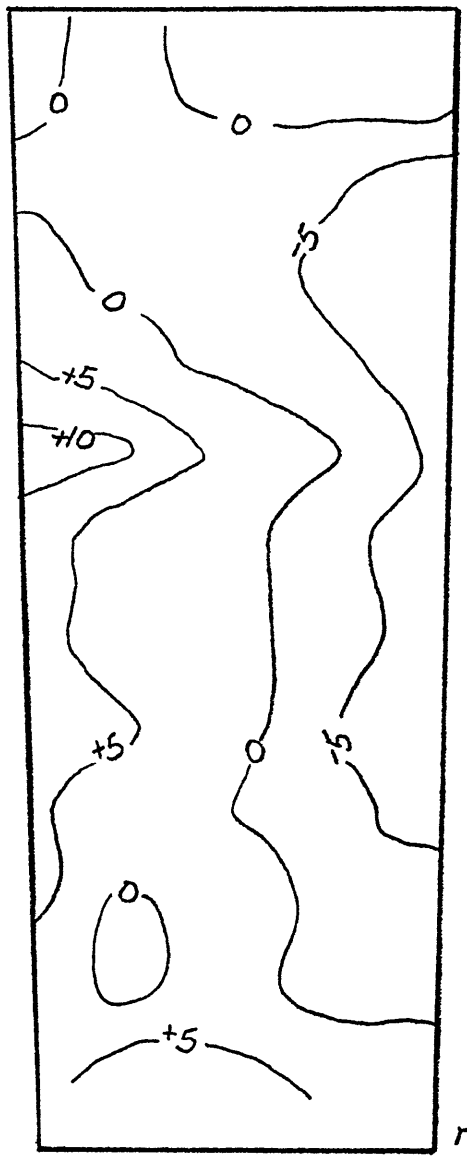


rms $(\Delta-\bar{\Delta})$
$= 1.3 \times 10^{-3}$ in.

S. Smith

Plate #2
H.P.R.

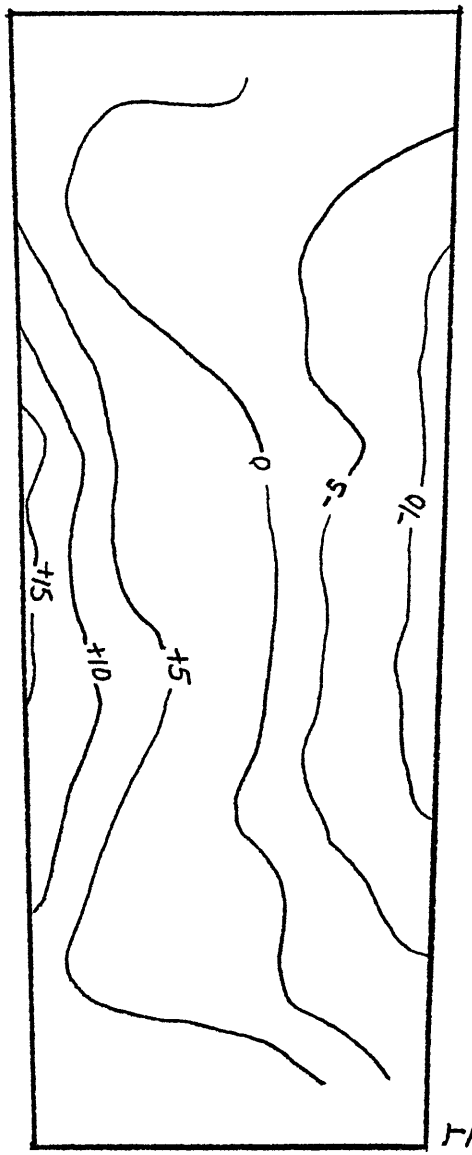
contour in
mm $\times 10^{-2}$



rms $(\Delta-\bar{\Delta})$
$= 2.0 \times 10^{-3}$ in

Wong

FIG. 2

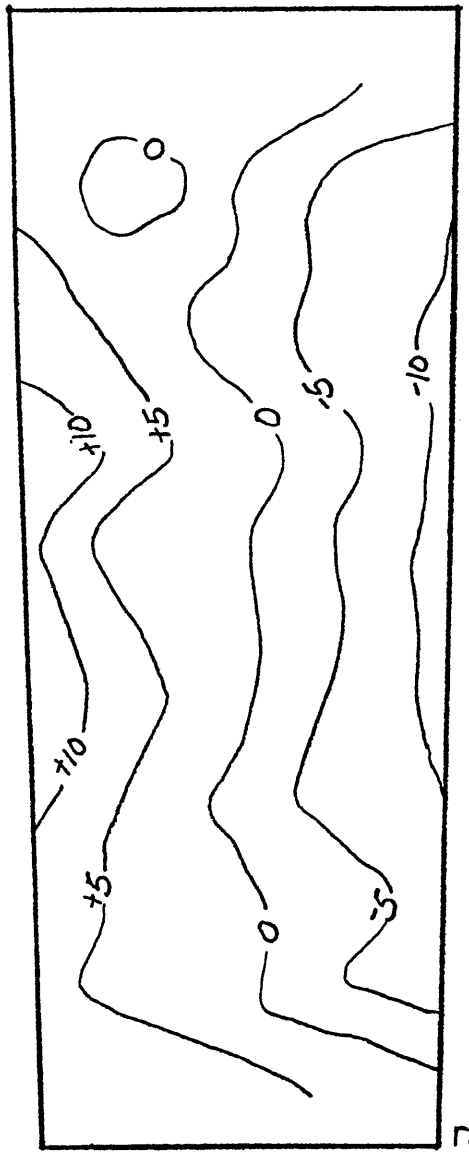


rms($\Delta-\bar{\Delta}$)
$= 3.0 \times 10^{-3}$ in.

Rohr

Plate #2
S.P.R.

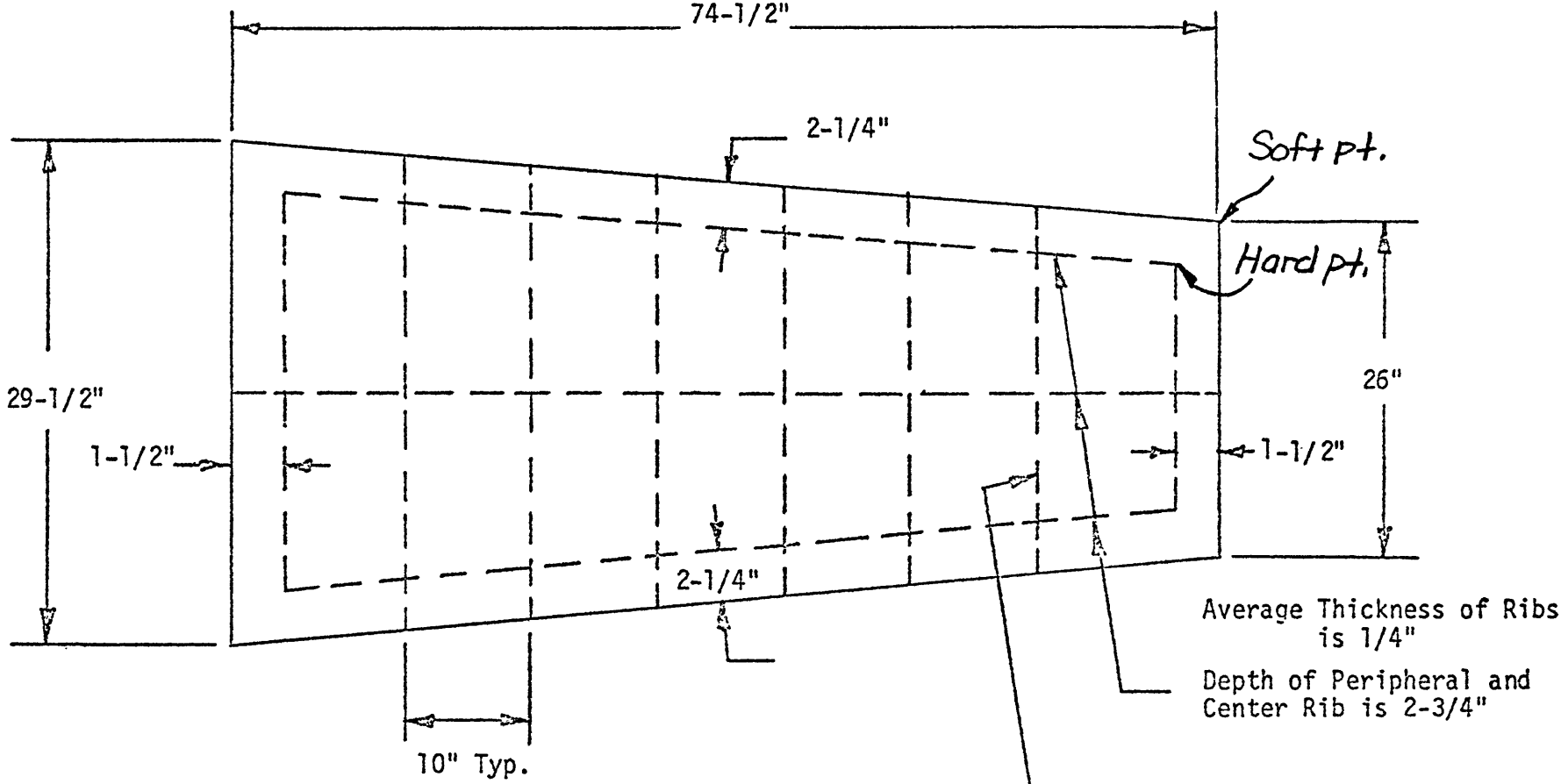
contour in
mm $\times 10^{-2}$



rms($\Delta-\bar{\Delta}$)
$= 3.0 \times 10^{-3}$ in.

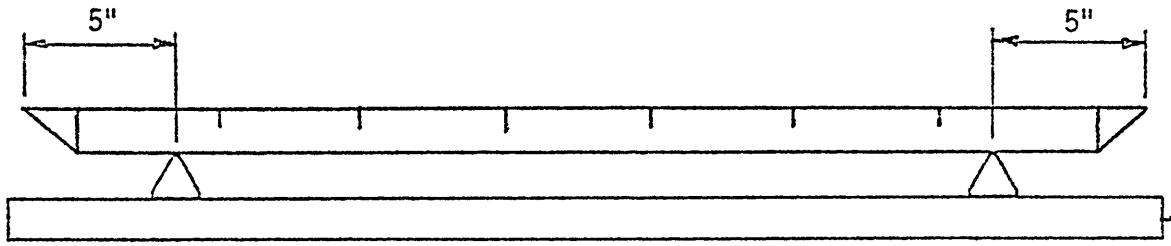
Wong

FIG. 3



Panel Thickness varies from 0.072 inch to 0.180 inch

PLAN VIEW



SIDE VIEW - showing supports during panel inspection

Figure ~~4~~ 3 4