

## National Radio Astronomy Observatory

Charlottesville, Virginia

August 19, 1974

To: 25<sup>m</sup> mm Wavelength Telescope Design Group

From: W.-Y. Wong

25 METER - MILLIMETER WAVE TELESCOPE

MEMO # 9

Subject: Thermal deformation of surface plate

Measurements of plates #1 and #2 showed that it is possible to specify a combination of manufacturing tolerance and dead weight deformation of 1.6 mils rms on surface plates at a constant temperature condition. (W.-Y. Wong's memo of August 13, 1974.) Additional measurement showed that it is also possible to specify the thermal deformation of 1.4 mils rms/1°F. I suggest these two memoranda are to be included in the request of proposal from firms for the new test plate(s) for the 25<sup>m</sup> mm wavelength telescope. These measurements indicated that the specifications on the new test plate(s) are not unreasonable and are possible to fulfill by present industrial technology.

Artificial thermal gradient was induced in the direction of depth of the plate by means of lamps hanging from above and fans blowing underneath. Since the plate was painted with a high reflectance white paint (Triangle #6), skin temperature as well as air temperature were measured on both sides of the plate. The average readings of the probes, after calibrations, are:

	<u>Avg. Reading (°F)</u>	<u>Temp. Difference (°F)</u>
Front - Air	87.3°	10.1°
Back - Air	77.2°	
Front - Skin	81.7°	1.1°
Back - Skin	80.6°	

The degradation of surface due to the thermal deformation is expressed as, in rms:

$$\sigma_T = \sqrt{\frac{1}{n} \sum_{i=1}^n \left( \Delta Z_O - \Delta Z_T \right)_i^2}$$

where  $\Delta Z_O$  = deviation of surface due to manufacturing error and gravity, and where  $\Delta Z_T$  = deviation of surface due to manufacturing error, gravity and temperature.

Based on the measured skin temperature difference,  $\sigma_T$  is found to be  $1.59 \times 10^{-3}$  in/1.1°F or  $1.4 \times 10^{-3}$  in/1°F.

Please note that the ratio of air temperature difference and the skin temperature difference is 9.2. It is true, at least for the surface plate, that the high reflectance white paint reduced the temperature gradient by that factor.