NATIONAL RADIO ASTRONOMY OBSERVATORY

25-Meter Millimeter Wave Telescope

Memo No. 129 Dec. 10, 1979

TO: 25 Meter Telescope Working Group

FROM: Engineering

SUBJECT: Cast Aluminum (A356) Surface Plate ANF #1

Attached are twelve contour plots of surface measurements on the prototype machined cast aluminum surface plate manufactured by Aeronutronics Ford in 1976. The plate was manufactured as part of their contract AUI 166. The contours represent the difference between the surface measured and the theoretical surface.

These contour plots form a brief history of the plate. It is noted the plots are comparable on plots 1 thru 4 (July 1976 to Jan. 1979). In the spring of 1979 the plate was loaned to Aerospace Corporation for tests, and evaluation in a research program they were doing for the Air Force relative to "light bucket" reflector materials. The plate was packed and shipped to California in the same crate and same manner it was shipped to Green Bank from St. Louis, Missouri in 1976. Plot no. 5 is for the surface measurements made by Aerospace after receiving the plate in California. This plot shows a major change in the plate surface from all previous measurements.

It was determined the plate was not floating free at all support points when the measurements were made. This could account for part of the "twisted" effect indicated. The slight pressure on two corners was not enough to cause the major change that had taken place. Aerospace agreed to remeasure the plate with the corners floating free similar to the way we measured the plate. This was done in October 1979, on the same machine it was measured on before, and observed by L. King and B. Peery. These measurements are represented by plot no. 6. The plate was packed up and shipped back to Green Bank the same way it was shipped out to California.

Plots 7, 8 and 9 are for measurements made in Green Bank, after the panel was returned, using the same measuring method used for plots 2, 3, and 4. These plots compare favorably with plot 6 indicating there was no change from California back to Green Bank.

In an attempt to understand the plate, three corners were locked in the zero position (on the reference plane) and the fourth corner raised 3 mm (.118") (1.4 turns of the nut on the threaded support). A set of measurements were made and are shown by plot 10. The plate was left in this deformed position overnight (approx. 18 hours) and measured again. These measurements are shown on plot 11. Plot 10 and 11 compare very good.

The plate was relaxed or returned to a floating condition on all four corners and measured again. This is shown on plot 12. Plot 12 is a good comparison with plots 6, 7, 8, and 9, indicating that small distortions do not cause any perceivable permanent change.

It is impossible at this time to explain what happened between plots 4 and 5. It is our opinion there was some physical force that caused this change but we cannot determine how or when. The plate and packing crate has been examined for marks that would indicate rough handling or dropping. There are none.

Plots 10 and 11 indicate the plate is flexible and will deform as the support points vary in position relative to each other. W-Y. Wong has reviewed his calculations with regard to the movement to be expected of each of the support points, on the telescope structure as it moves to other positions, and finds that the expected variations between support points for individual panels is approximately .001 in (.025 mm). The distortion or change in shape for this small movement is within the error budget.

The flexibility of the panel explains why the four control points could be set to 0 (on the reference plane) when NRAO was making measurements with the four corners floating (resting on a point support). It was found that one corner could be raised approximately .3 in. (.8 cm) before either of the other three free support points changed position.

It is our conclusion the machined cast aluminum plate is a viable type panel that can meet and maintain the specifications set forth in our 25 meter proposal. This exercise does point out areas which should be controlled very carefully during manufacturing and operation. They are:

1. Plate structure - ribs and thickness
2. Heat treating and stress relieving
3. Handling
4. Crating and shipping
5. Supporting on structure.

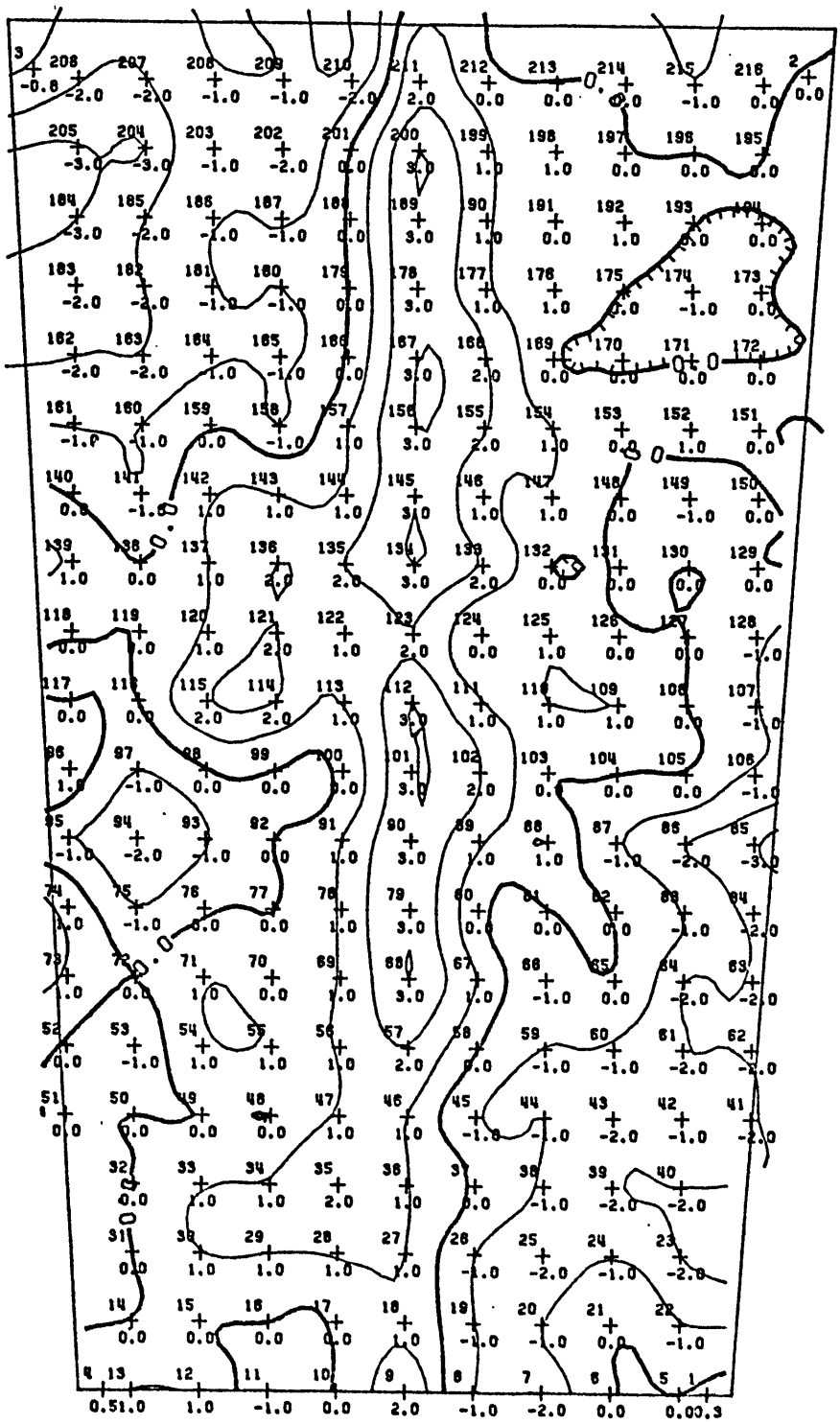
We propose to make more measurements on the plate relaxed, loaded and distorted to further understand the plate and develop data for the plate specifications.

cc: L. King
S. Smith
W-Y. Wong

25M - SURF. PLT AF-01

(JUL. 15, 1976 DATA .001" CNTOUR)

AERONUTRONIC-FORD 216 POINTS
RMS = .0013 IN. (.034 MM)



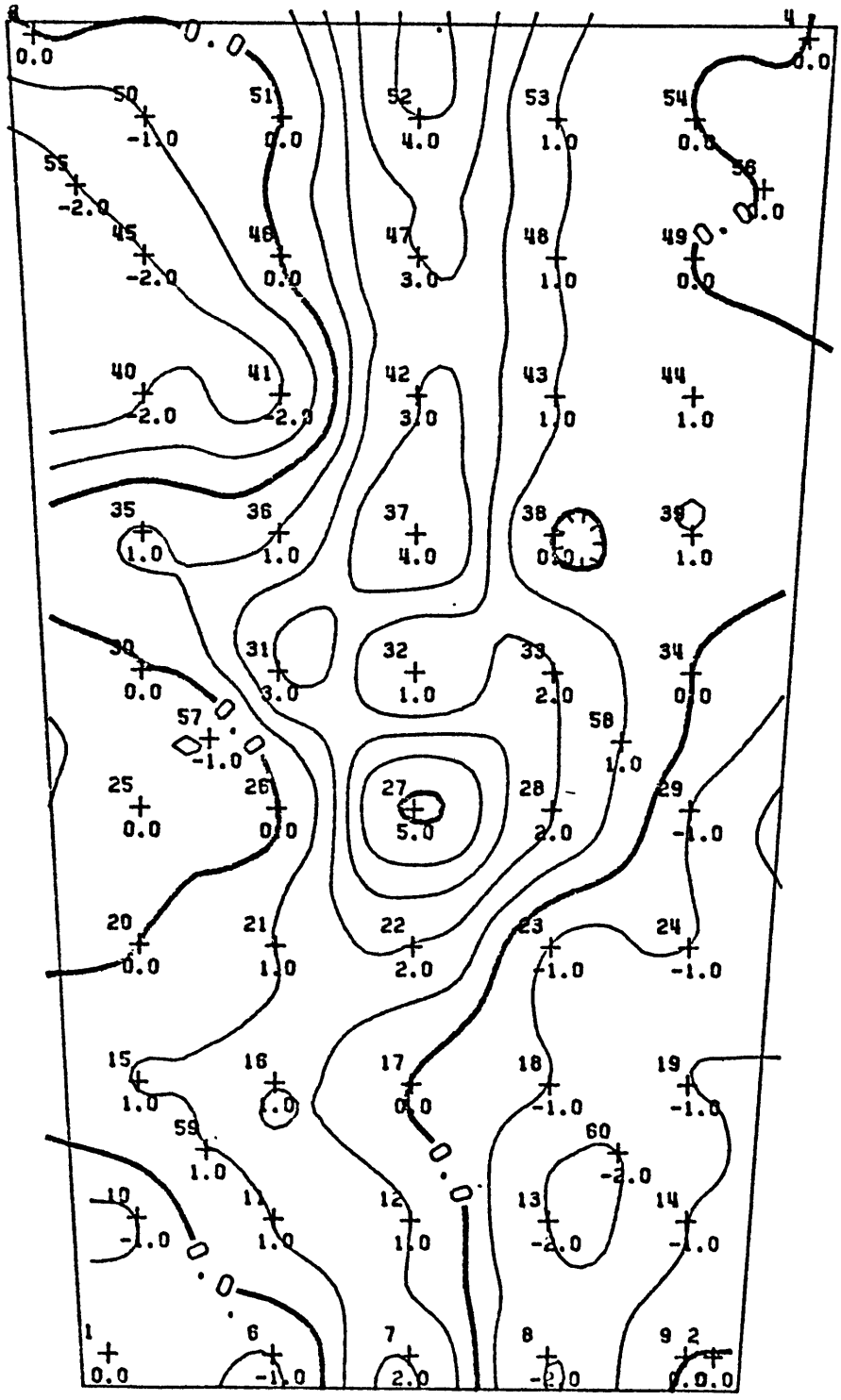
Meas. by ANF July '76 (.0013" RMS) (.034 mm)

25M SURF PLT AF-01

(DEC. 17, 1976 DATA .001" CNTOUR)

2

CONTROL PTS SET TO ZERO (SQ)
RMS = .0016 IN. (.041 MM)

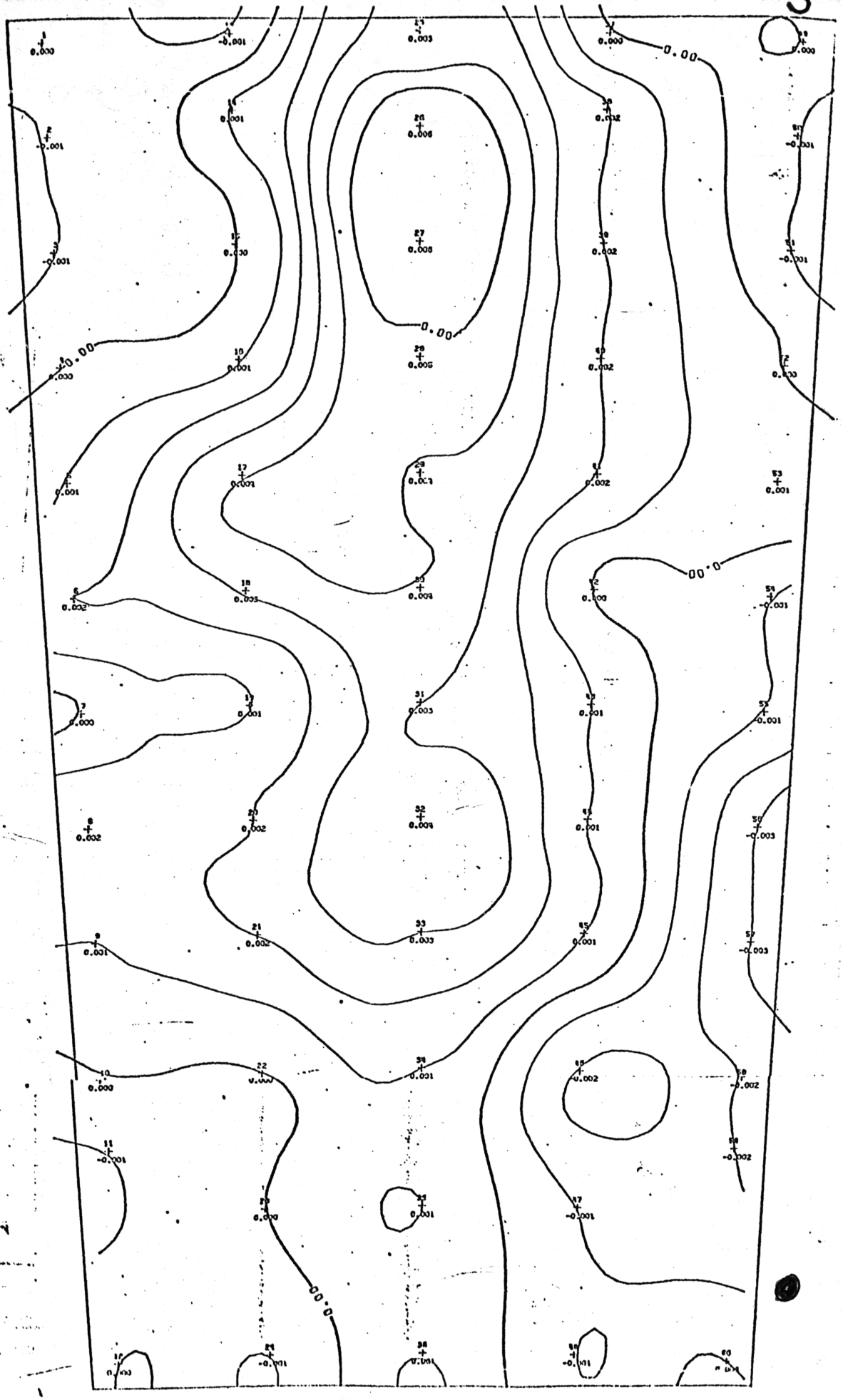


Meas. by NRAO Dec. 76 (.0016" RMS) (.041 mm)

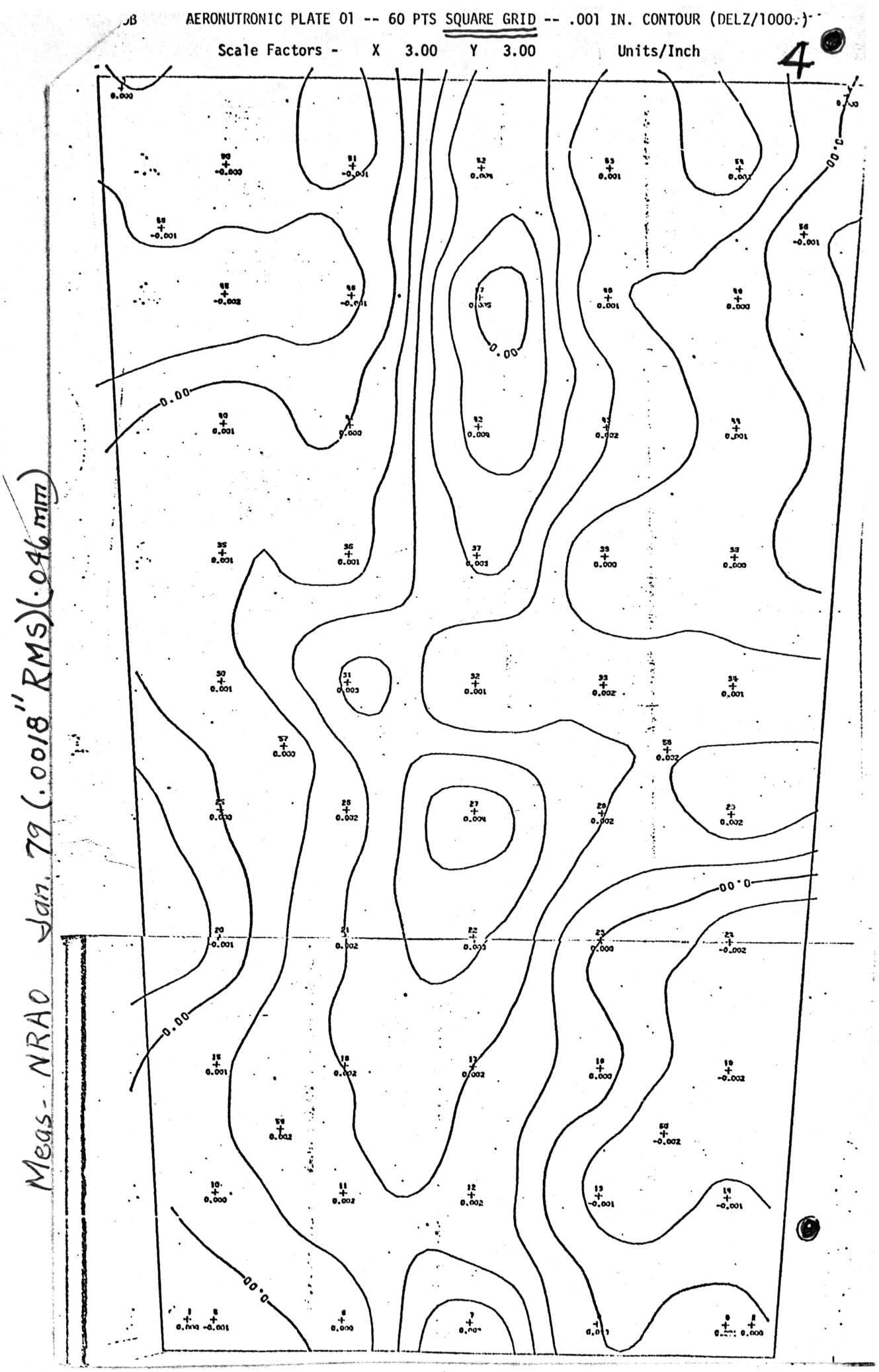
JOB AERONUTRONIC PLATE 01 -- 60 PTS RAD GRID -- .001 IN. CONTOUR (DELZ/1000.)

Scale Factors - X 3.00 Y 3.00 Units/Inch

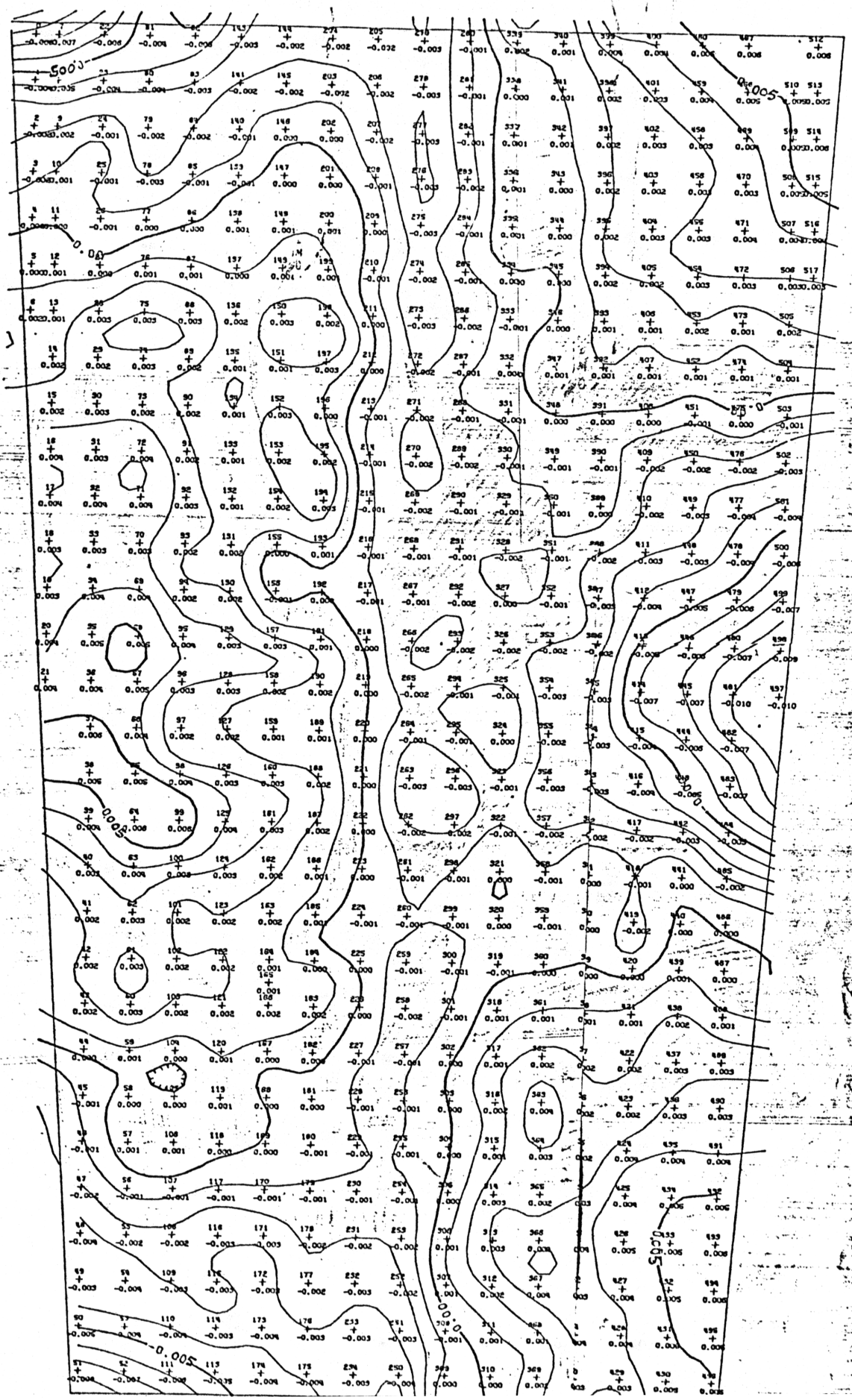
3



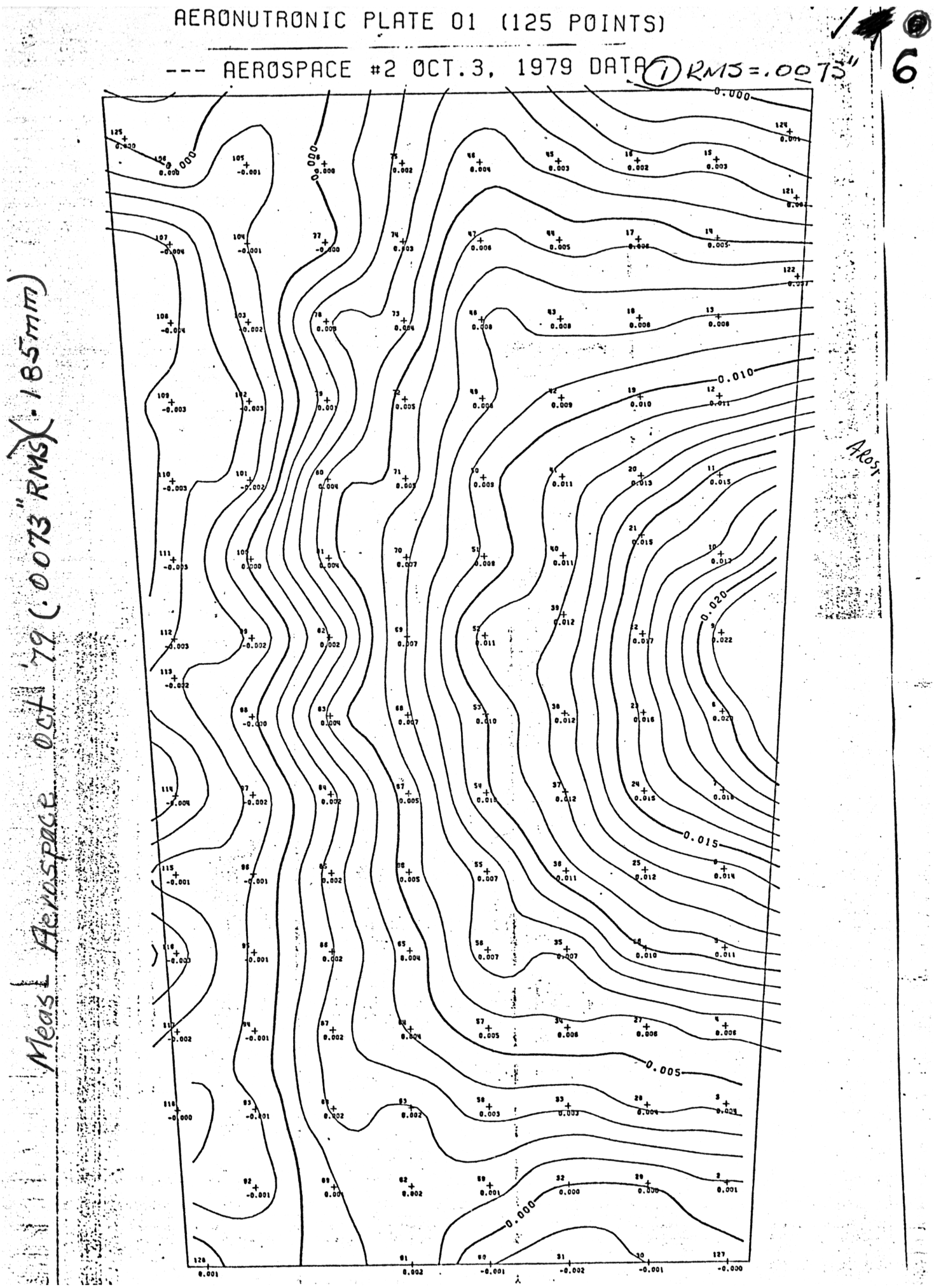
Mega- NRAO Dec. '76 (.0021" RMS) (.053mm)


AERONUTRONIC PLATE 01 -- 60 PTS SQUARE GRID -- .001 IN. CONTOUR (DELZ/1000.)
Scale Factors - X 3.00 Y 3.00 Units/Inch
4
0.00
Meas - NRAO Jan. 79 (.0018" RMS) (.046 mm)

TILCO-FORT PLATE #1 — BEST-FIT DATA (AERO 493 PTS)



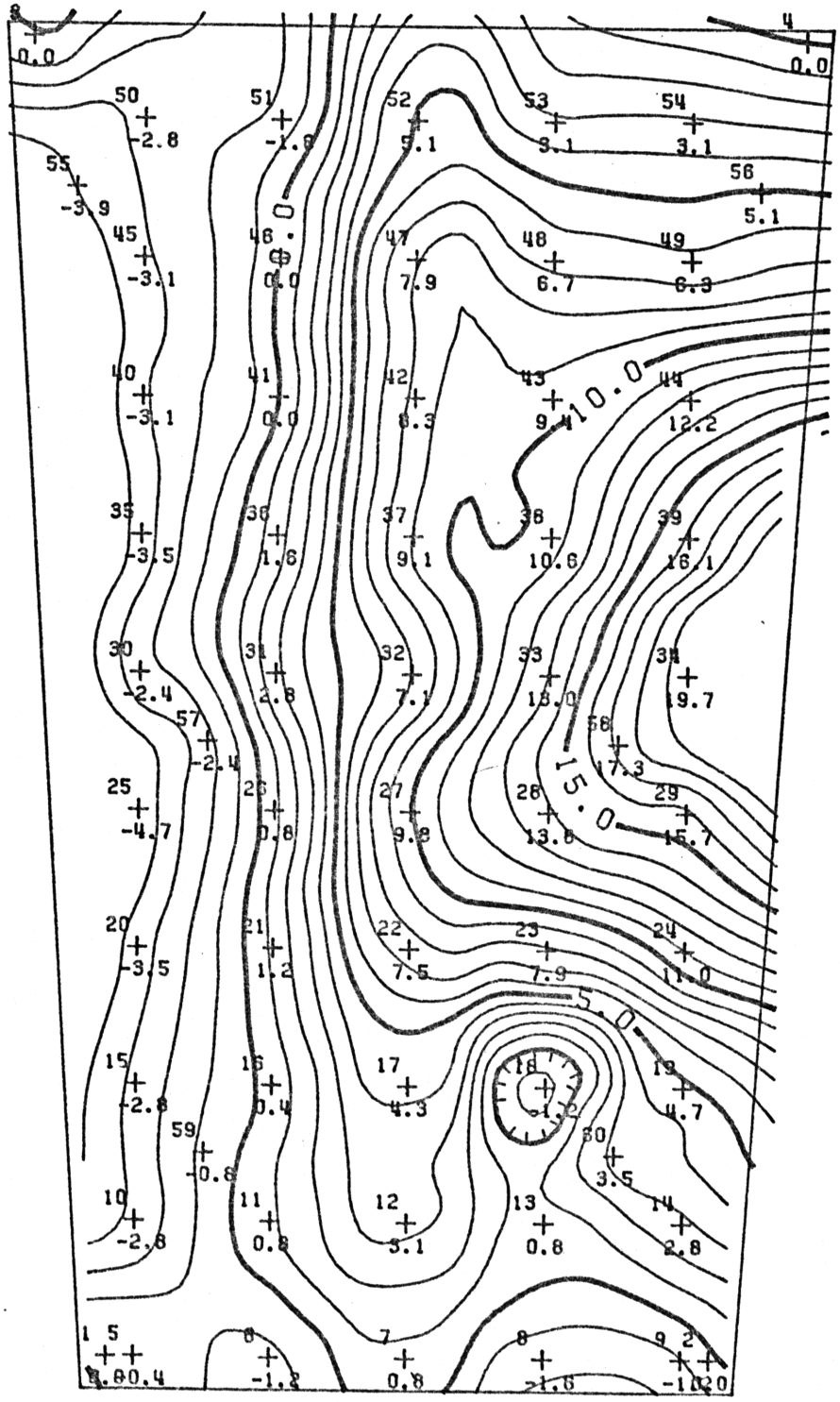
Meas. by Aerospace June '79 (.032")(.081 mm)


AERONUTRONIC PLATE 01 (125 POINTS)
--- AEROSPACE #2 OCT. 3, 1979 DATA (1) RMS = .0073"
0.000
0.005
0.010
0.015
0.020
Meas'l Aerospace Oct '79 (.0073" RMS) (.185mm)
Aeros

25M SURF PLT AF-01

(NOV. 16, 1979 DATA .001"CNTOUR)

[redacted] CONTROL PTS SET TO ZERO
RMS = .0069 IN. (.176 MM)



Meas. NRAO Nov. 79 (.0069" RMS) (.176 mm)

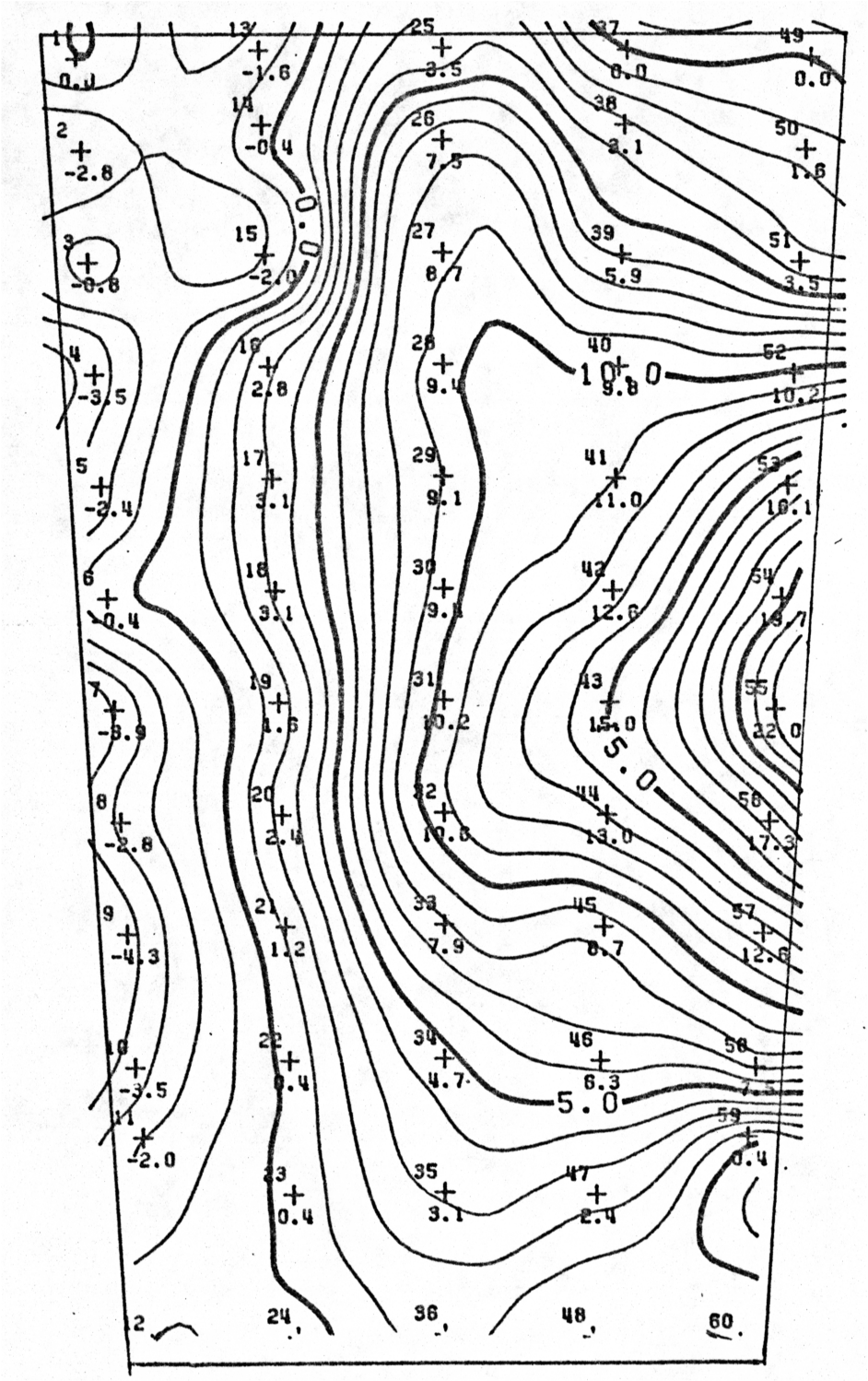
Rad

25M SURF PLT AF-01

8

(NOV. 16, 1979 DATA .001"CNTOUR)

[redacted] CONTROL PTS SET TO ZERO
RMS = .0077 IN. (.195 MM)



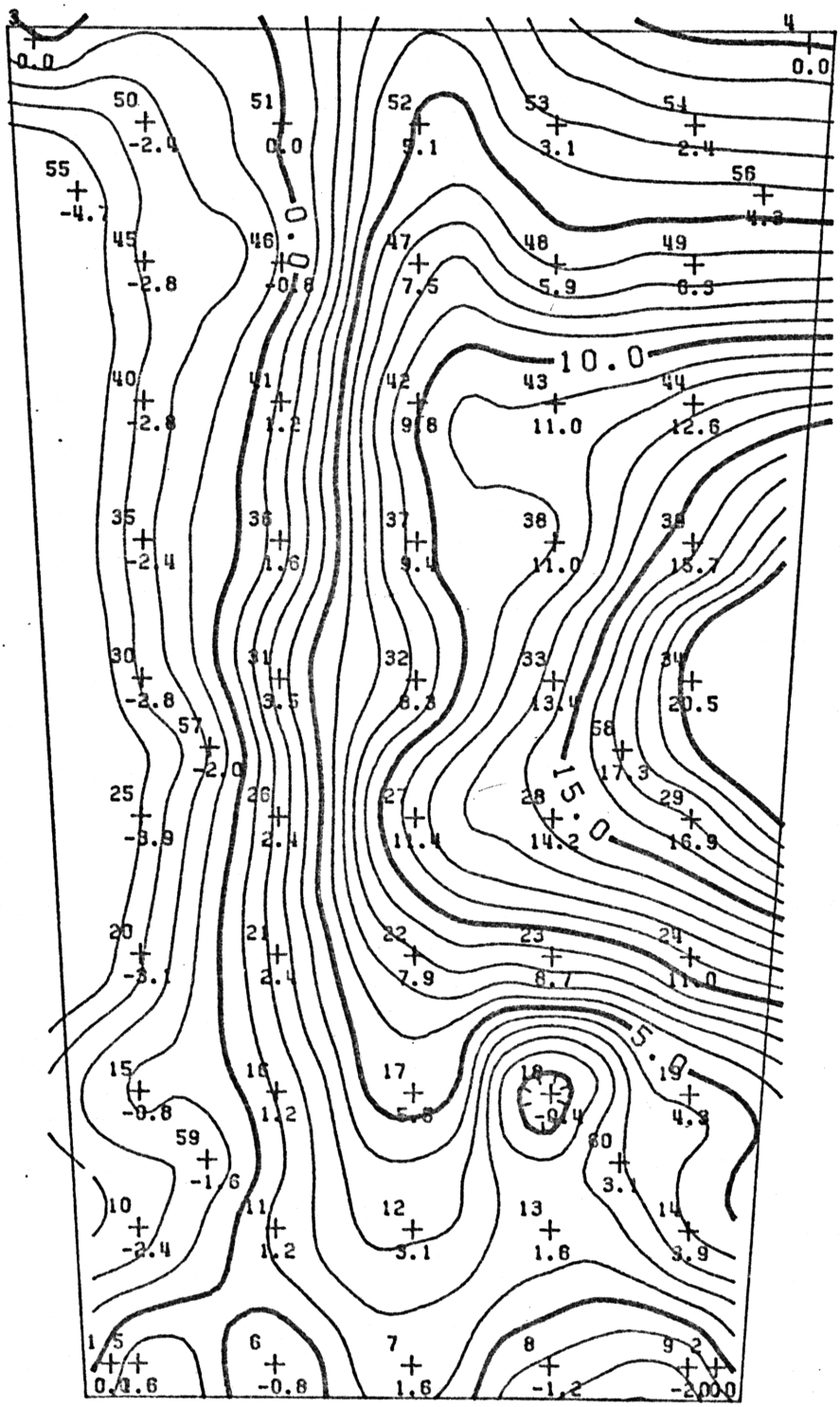
Meas. NRAO Nov. 79 (.0077" RMS) (.195 mm)

9

25M SURF PLT AF-01

(NOV. 19, 1979 DATA .001"CNTOUR)

[redacted] CONTROL PTS SET TO ZERO
RMS = .0072 IN. (.182 MM)



Meas. NRAO Nov. 79 (.0072 RMS) X (.182 mm)

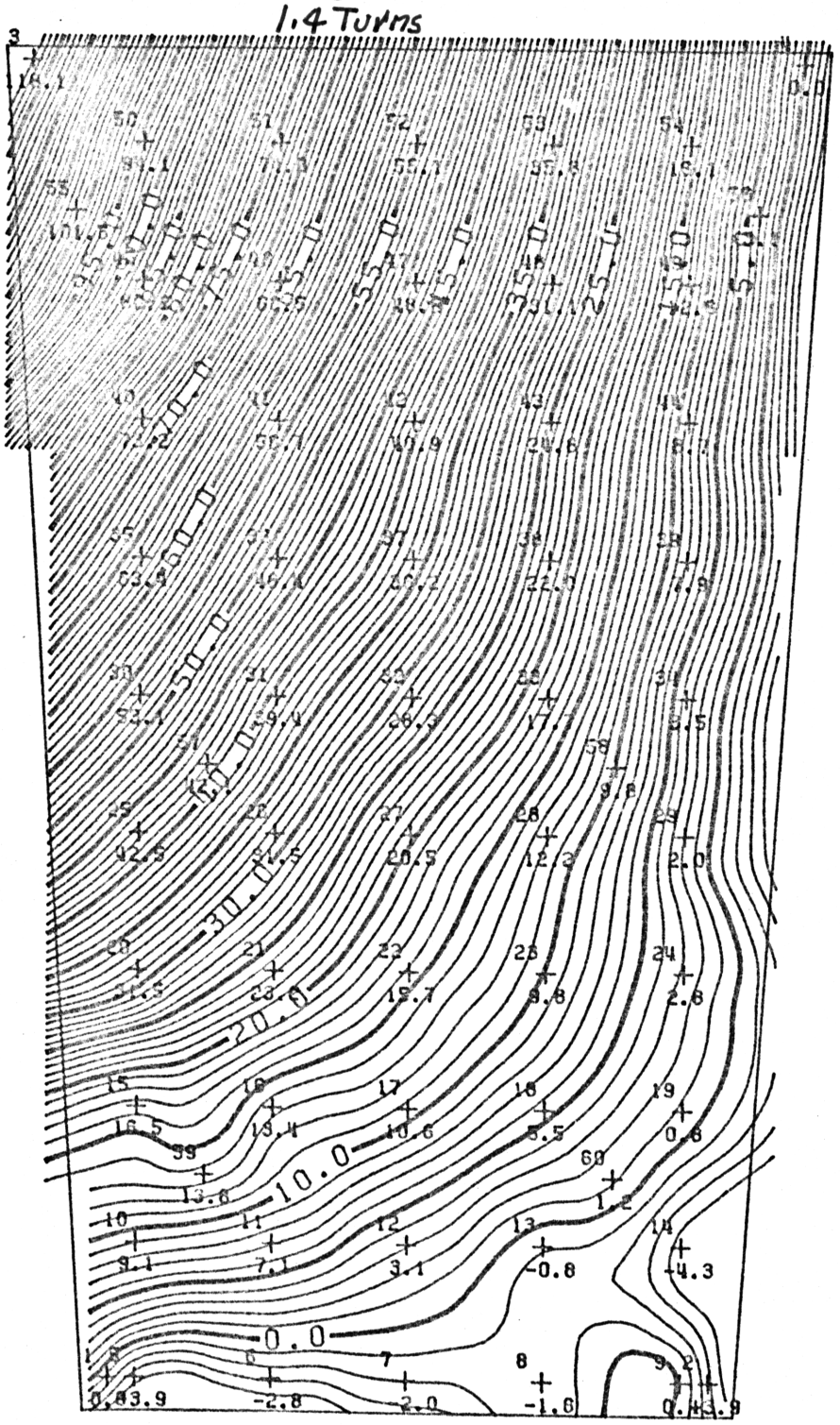
25M SURF PLT AF-01

10

(NOV. 19, 1979 DATA .001"CNTOUR)

[redacted] SURF CONTOUR DUE TO CP#3
RAISED 3MM, (RMS=.038")

.118
1.4 Turns



MEAS. NRAO NOV. 79 (.038" RMS) (.965 mm)

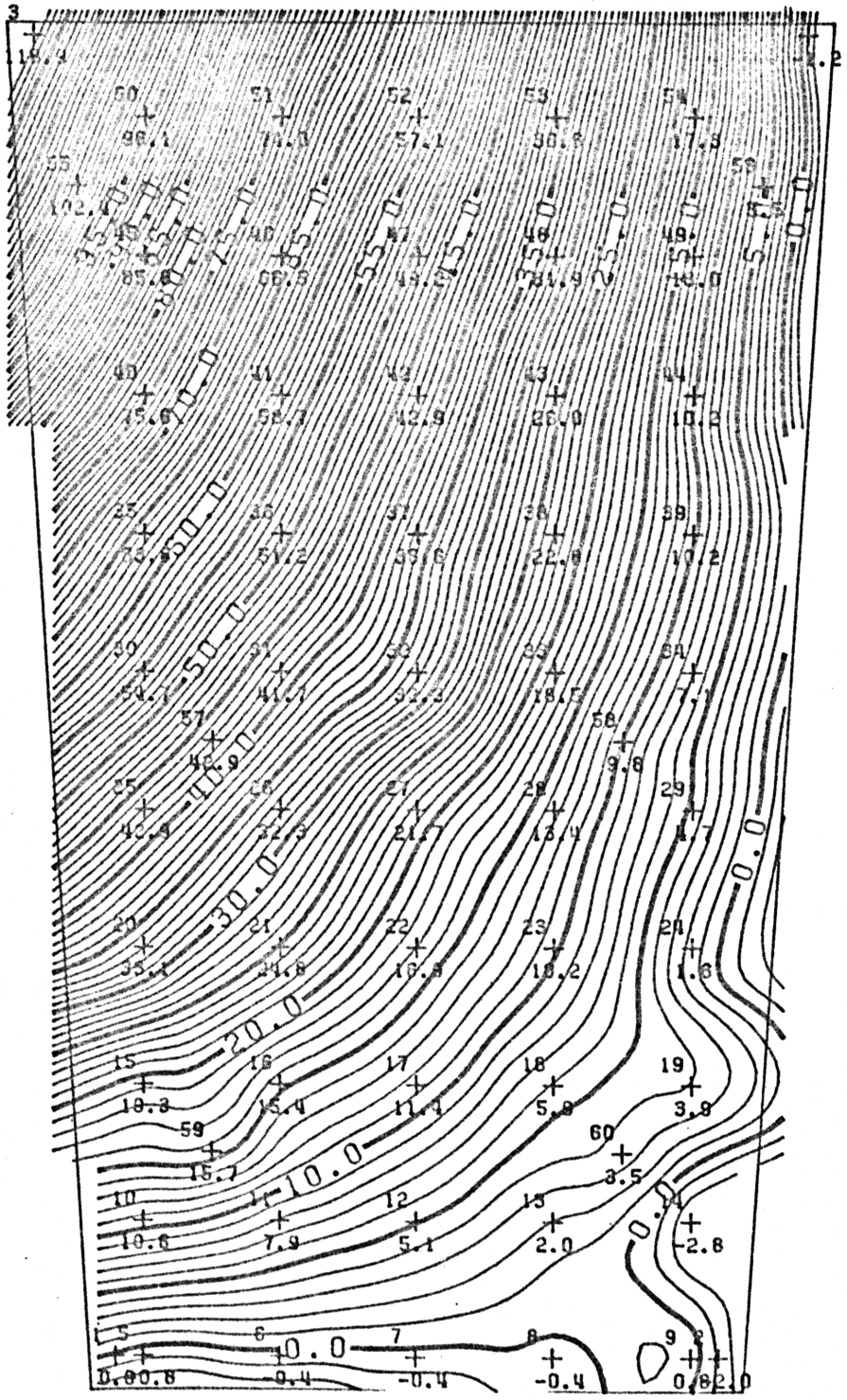
25M SURF PLT AF-01

(NOV.20,1979 DATA .001"CNTOUR)

11

10

[redacted] SAME AS [redacted] EXCEPT DIST PLT
LEFT OVERNITE (RMS=.040")



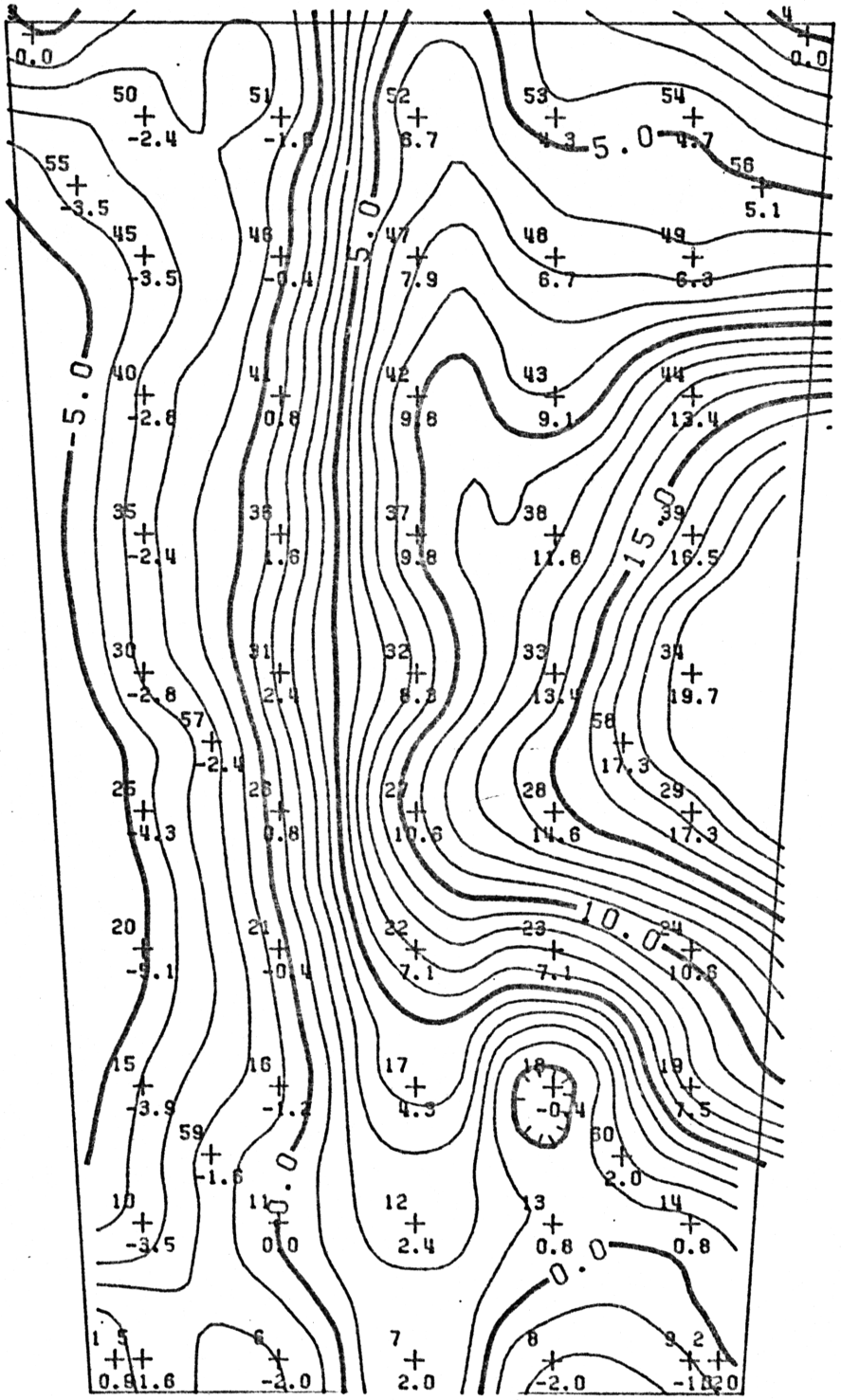
Meas. NRAO Nov. 79 (.040" RMS) (1.016 mm)

25M SURF PLT AF-01

(NOV.20,1979 DATA .001"CNTOUR)

12

[redacted] CPS RE-SET TO ZERO AFTER
DIST SEE [redacted] & [redacted] RMS=.0072"
10 11



Meas NRAO Nov. '79 (.0072" RMS) (.183mm)