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**NATIONAL RADIO ASTRONOMY OBSERVATORY**  
Socorro, New Mexico

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VLBA Antenna Memo Series No.35

**VLBA SUBREFLECTOR MEASUREMENT AND REPAIR**

J. E. Thunborg  
August 22, 2000

**Attachments:**

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During the VLBA test meeting August 16, 2001, the need to repair VLBA subreflectors was discussed. The VLBA-Brewster antenna will not produce useful results at 3 mm unless its subreflector surface is repaired. The subreflector surface on the VLBA-Hancock antenna shows signs of degradation and also needs to be repaired. Reworking the subreflectors at other VLBA antennas would also enhance their performance at shorter wavelengths.

This memo describes a method of resurfacing the subreflector using a FARO Arm Metrology system accurate to  $\pm 0.002''$ . Using this technology, we should be able to resurface subreflectors to a RMS accuracy of  $0.010''$ . Greater accuracy might even be achievable as we gain experience with the process.



**Repair Method:**

The subreflector will be mounted vertically in a steel fixture with its axis of symmetry parallel to the ground. Vertical mounting enables a reasonable work position when working on the top half of the subreflector. The top half of the subreflector surface will then be mapped using an 8-foot diameter Faro Arm mounted on a precision rail. The precision rail enables us to utilize the greater accuracy of a shorter Faro Arm. Contour lines representing the deviation from the ideal surface will be drawn on the subreflector. As proposed by Jim Ruff, scratches to the correct depth will then be scribed into the subreflector surface. Next, The surface will be hand worked to remove the scratches.

When the top half of the subreflector is within specification, the subreflector will be rotated 180 degrees. Precision tooling points on the finished subreflector surface will be used to accurately orient the unfinished half of the subreflector with respect to the finished surface. The unfinished half of the subreflector will then be reworked using the method described above.

When the entire subreflector surface is within specification, new RF-reflective and white coatings will be applied. Walter Brisken is currently researching coatings and coating procedures.

## Resources necessary for subreflector repair

### Facilities:

The most logical place to rework subreflectors is in the FRM shop located in the southwest corner of the antenna barn. This workshop is somewhat temperature controlled. Temperature control is essential to satisfy the stringent accuracy requirements. The FRM shop also has a high ceiling, which is necessary to accommodate a 12-foot diameter subreflector. Use of the FRM shop for subreflectors would require the FRMs to be serviced in the old FRM shop, which is currently occupied by the electricians.

### Non-Recurring costs:

8' Gold Series Faro Measuring Arm with training and software. +/-0.002 Accuracy	\$39,300
10' Faro precision rail	\$13,200
Subreflector holding fixture. (steel weldment)	\$2,000
Specialized hand tools needed for surface repair.	\$2,000
<u>Dust recovery system.</u>	<u>\$2,000</u>
Total	\$58,500

### Recurring Costs/Subreflector:

Travel to site 3 men, 1 week.	\$4500
Coatings. Paint, aluminum, silver, etc.	\$3000***
Miscellaneous expendables. (paint tips, sandpaper, PPE)	\$500
<u>Onsite crane rental.</u>	<u>\$2,500</u>
Total	\$10,500

\*\*\* Wild guess.

### Non-Recurring Labor:

Engineering (Faro training, fixture design)	4 Man weeks
Welding (Fixture building)	6 Man weeks
HVAC Shop air control	1 Man weeks

### Recurring Labor/subreflector:

Engineering (Subreflector installation/removal on site), metrology	2 Man weeks
Antenna Mechanics (Subreflector installation/removal on site)	2 Man weeks
Subreflector Repair Technician	10 Man weeks
Painter	1 Man Week