NASA TECH BRIEF

Ames Research Center

Manufacture of Large, Lightweight Parabolic Antennas

The manufacture of large parabolic antennas is particularly difficult because close tolerances are imposed on surface dimensions. Moreover, since lightweight material must be used for spacecraft antennas (e.g., 0.13-mm aluminum foil sandwich construction), it is necessary to use film adhesives and bonding techniques, and these manufacturing processes lead to additional difficulties in maintaining tolerances because of strains from the heating and curing of adhesives.

In order to minimize problems in manufacture, a 2.7-m parabolic antenna for a Pioneer spacecraft was produced in segments; the parabola was formed from a center section 0.81 m in diameter surrounded by twelve 0.89-m sections. The sections were built up as an aluminum foil sandwich with a 1.6-cm aluminum core bonded by a film adhesive; the whole structure was oven-cured after assembly.

The antenna structure was readily assembled with the aid of a special tool (actually a large fixture) for splice-bonding the 12 segments into a complete dish, and an inflatable bladder to apply pressure at the joints during the cure; a portable oven was used to apply heat rapidly and evenly to the whole assembly.

The assembly tool is an aluminum structure which supports the outer segments of the antenna dish only in the splice areas and the outside-diameter trim areas; thus, during oven cure, there is unimpeded circulation of the oven air and all areas of the dish are heated uniformly. Additionally, the tool is designed with adjustable segments so that after thermal cycling it can be checked and realigned if necessary.

A steel spider, almost a mirror image of the fixture upon which the antenna segments are laid, is constructed to contain a rubber bladder which conforms to the full width of the splice when inflated; the inflated bladder applies a uniform pressure (between 34 and 69 kN/m^2 [5—10 psi]) on all seams in the antenna structure. Also, the splice areas are covered with epoxy-fiberglass laminate and 4.6-mm neoprene rubber so that pressure is distributed equally, even in the presence of surface irregularities.

Because the fixture with the spider and bladder represents a fair amount of mass, it was designed to be moored to a concrete floor; this simplified the design and construction of a stable assembly fixture and allowed the use of inserts in the floor for pressure application. The curing oven was assembled so that it could be moved to the fixture after all the segments were in place.

Contour inspection of four antennas manufactured as described has shown that the rms of the half-wavelength deviation was 0.15 mm and the maximum deviation was +0.53 mm and −0.46 mm. Specifications for the antenna are an rms of normal deviation within 0.76 mm and a maximum normal deviation within ±2.3 mm. A special advantage of the technique is that when a parabola is assembled with small sections, they have less distortion from the cure of the resin system and tolerances can be more closely controlled in the final assembly.

(continued overleaf)

Note:

Requests for further information may be directed to:

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Patent status:

NASA has decided not to apply for a patent.

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