NATIONAL RADIO ASTRONOMY OBSERVATORY

ELECTRONICS DIVISION TECHNICAL NOTE NO. 100

TITLE: Loss of Plated Stainless Steel Waveguide at 100 GHz

AUTHOR(S): C. Coates

DATE: January 22, 1979

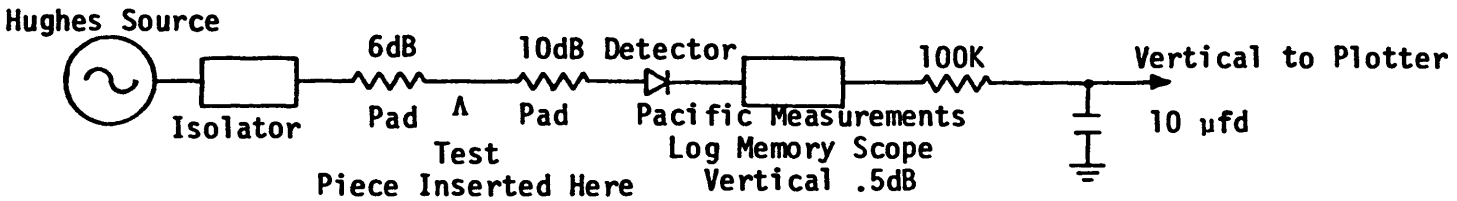
Introduction

The purpose of this investigation was to secure information on the dB loss per centimeter for WR-10 waveguide with the following interior finishes:

1. Gold
2. Copper
3. Copper Treated with a Passivating Agent
4. Coin Silver (Solid Coin Silver Piece)

Equipment

Three pieces of WR-10 waveguide 18.7 centimeters in length were plated and the dB loss was measured by inserting the plated pieces into a previously calibrated test setup.



Procedure

The three pieces of WR-10 waveguide each had the brass flanges soldered in place. A jig for one end was made consisting of one flange on a piece of waveguide to facilitate insertion into tubing.

This would allow pumping of plating solutions through the waveguide. A platinum wire was used as the anode and agitated in the interior of the waveguide. The plating procedure was as follows:

1. Rinse in Acetone
2. Electroclean
3. Rinse
4. Nickel Acid Flash
5. Rinse
6. Plate Copper or Gold

One piece was plated gold and two were plated copper. One of the copper pieces was immediately passivated by immersion into an Allied Kelite product, Iridite 7P Metcote Mix A diluted (1 part Mix A: 5 parts water), for 10 seconds.

The pieces were then dried and inserted into the test setup and dB loss recorded. These values were compared to existing coin silver waveguide, and two commercially plated gold plated waveguides. Each piece was plated to a thickness of approximately 3 skin depths for 100 GHz or 15 micro inches. After the initial tests, the new gold piece was plated to 45 micro inch thickness, and the copper piece was treated with Metcote.

Results

Table 1

Material	Mean dB Loss per CM
Coin Silver	0.038
First New Gold (15μ")	0.167
Second New Gold (45μ")	0.064
Copper Plus Metcote	0.043
Copper - (First)	0.075
Copper - (Second - delayed Metcote)	0.066
First Old Gold (20μ")	0.065
Second Old Gold (20μ")	0.125

The above results were averaged between 112 and 113 GHz, the typical frequency variation was $\leq$ 0.005 dB/cm. The theoretical losses for coin silver, copper and gold are 0.031 dB/cm, 0.025 dB/cm, and 0.029 dB/cm respectively.

The piece that came closest to the coin silver was the treated copper. It is not known at this time what the "shelf life" of passivated copper might be. It is interesting to note that when the passivating agent was applied after the copper had been dried, it had less effect than when treated immediately after plating. There was also quite a variation in the value of the new gold with 15 and 45 micro inches perhaps indicating areas inside the waveguide with a light layer of gold. The variation in the old commercially gold plated waveguide could be accounted for by the previously mentioned problem or by waveguide whose dimensions are not within tolerance.