TEXAS STATE UNIVERSITY
The rising STAR of Texas

1.02 - Team Wave

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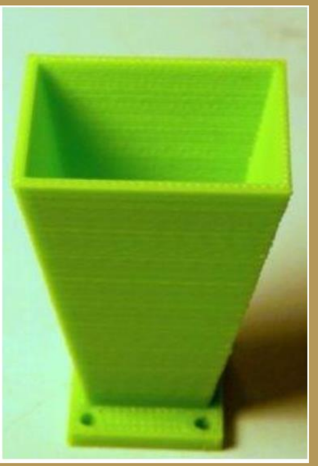
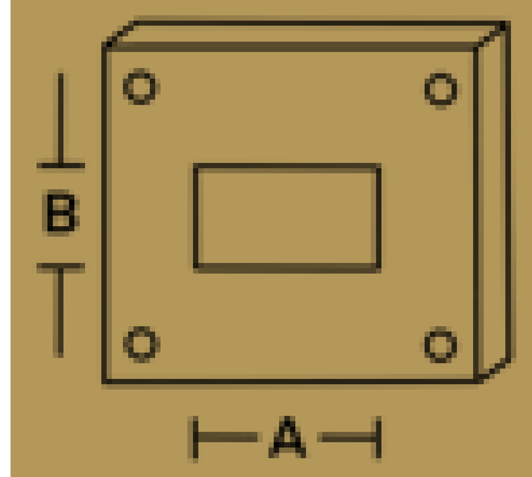
Prototype Waveguide Components



What is the WR-90 Standard?



Features

- 8.2-12.4 GHz range.
- WR-90 flange has the following dimensions:
  A = 22.82 mm
  B = 10.1 mm

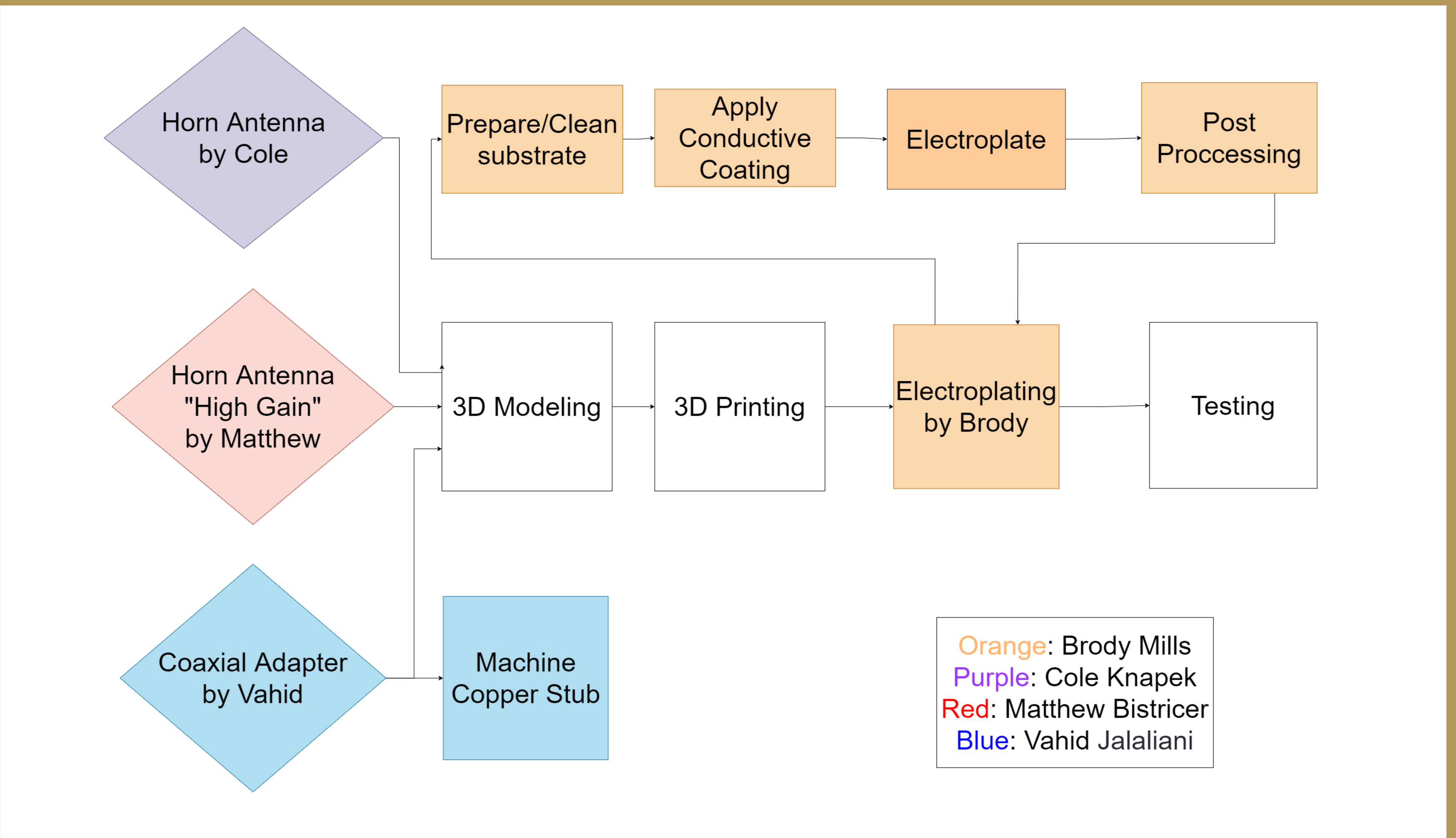
- We are using this standard because this is the standard of the commercial waveguide components that we have access to test.

D2 Plans

Our Plans for D2

- Combine with team 1.03.
- Improve the design of the waveguide components
- Improve the quality of electroplating
- Comprehensively test the waveguide components and electroplating process
- Design and construct the communications demo.

Design



Waveguide Production Process Flow Diagram

What are Waveguides?

- Structures that transmit waves with low losses using their shape and physical characteristics.
- Focus EM waves in one direction, instead of letting them propagate normally.

Why 3D Print?

- Fabrication time is much lower
- Cost of PETG is much lower
- Iterative design improvements become achievable
- 3D printed components weigh less than commercial components.

Electroplating Process

Why Electroplate?

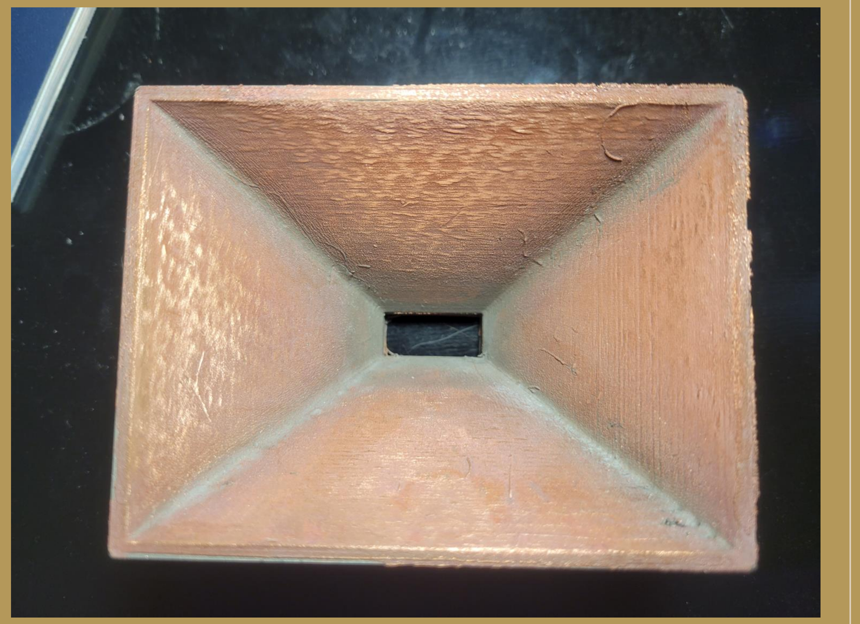
- We are electroplating the components to give them the conducting layer necessary to transmit high-frequency EM waves.

Steps in the electroplating process

- Sanding the printed components
- Cleaning the printed component in acidic solution
- Applying conductive paint to create a seed layer
- Create custom anode and fixture
- Electroplating the components in a copper ion solution

Why is Thickness Important?

- Without the electroplated layer reaching a specific level of thickness, there will be significant, measurable losses in transmitted signals due to the skin effect.
- The required electroplating layer thickness is no less than 7µm, 10 times one skin depth of copper at 8 GHz : 0.7 µm



Requirements

Insertion Loss: The loss in signal magnitude that happens through the waveguide.
VSWR: A measurement that maps to the power delivery efficiency of the waveguide
Half Power Beam Width: The angle from the center of the antenna where beam power is cutoff (halved)

Low Gain Horn Antenna
- Insertion Loss: Less than 0.3 dB
- VSRW: Less than 1.3
- Half Power Beam Width: 42° x 43°

High Gain Antenna
- Insertion Loss: Less than 0.3 dB
- VSRW: Less than 1.3
- Half Power Beam Width: 15° x 15°

Coax-to-Waveguide Adapter
- Insertion Loss: less than 0.5 dB
- VSRW: Less than 1.5

Commercial Components Performance

Low Gain Horn Antenna
- Insertion Loss: Maximum of 0.23 dB
- VSRW: Less Than 1.20
- Half Power Beam Width: 47.4° x 48.5°

High Gain Antenna
- Insertion Loss: Maximum of 0.23 dB
- VSRW: Less Than 1.20
- Half Power Beam Width: 16.5° x 16.1°

Coax-to-Waveguide Adapter
- Insertion Loss: less than 0.5 dB/m
- VSRW: Less than 1.5

Cost Restrictions

The per-unit cost of the components that we are designing have a limit of being less than 20% of the price of their commercially available counterparts.

Horn Antenna
- Max Cost: $173

High Gain Antenna
- Max Cost: $300

Coax-to-Waveguide Adapter
- Max Cost: $72

**Retrieved from Pasternack Website*