Omega Cylinder Rayleigh-Taylor Target Fabrication (FY2023/2024)

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Abstract

LANL is producing single-cylinder implosion targets for use on the Omega chamber at the Rochester LLE. The design of these target are recommended by the physics team, with appropriate approval from the target fabrication team. The construction of the target consists of an internal aluminum plating, with an external coating of Epon, then back-machined into the correct 'cylinder' form. Once produced, these targets are then sent to Rochester LLE where the shot experiment can take place. The poster will cover the manufacturing of the cylinder targets.

CylDRT Physics Goals

Cylinder project will study re-shock in single cylinders and the effects of small grain structures on compression, mix, and heating. [1]

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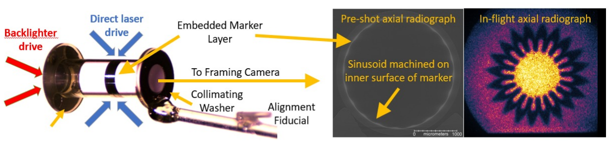
Cylindrical targets provide compression and heating of a central fuel while retaining direct diagnostic access for radiography.

- Cylindrical implosions are used to study physics in convergent geometry

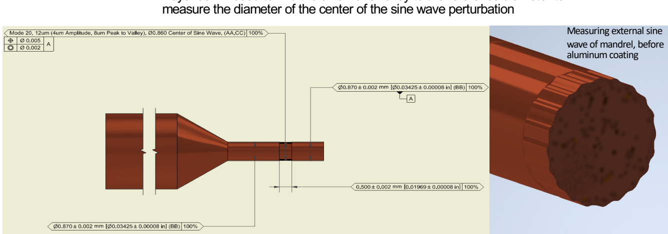


- The addition of spectroscopic dopants in the central gas region has been used to diagnose core conditions and infer the temperature of the fuel [1]

Step 1: Machine Mandrel

Machine Mandrel with Internal Sine Waves

- Machine mandrel with Fast Tool Servo to desired sine wave
  - Mode-10 and Mode-20 sine waves machined in FY23/24
- Measurements taken after the machining process to verify design
  - Keyence IM used to measure reference diameter next to sine waves
  - Contact Sensor used to measure the sine wave amplitude (~8um P-V) and the mode of sine wave (mode 10 or 20; AA, CC)
  - Keyence VK used to find the sine wave valley to the reference diameter to measure the diameter of the center of the sine wave perturbation

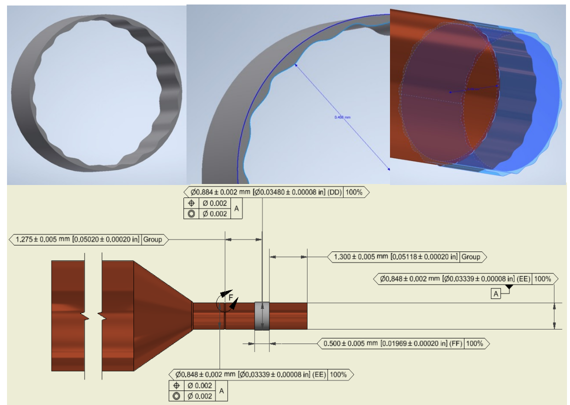


[1] Omega FY24 Cylinder Shot Request; J. P. Sauppe, J. F. Dowd, K. A. Flippo, N. M. Hoffman, B. M. Haines, N. S. Christiansen, D. W. Schmidt; 2/1/22

Step 2: Aluminum Layer

Aluminum Coating and Back-machining Aluminum

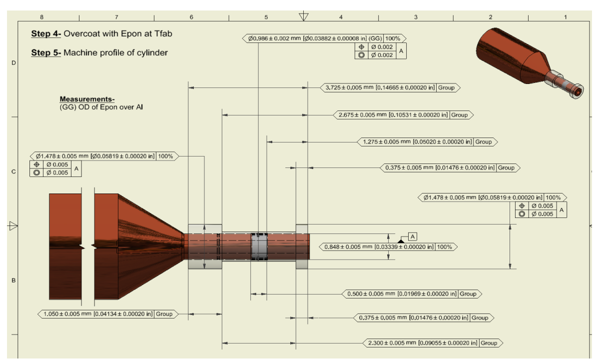
- Mandrel is then coated with aluminum, coated extra thick
  - Coating performed by AlumiPlate electroplating
- Back-machining of aluminum aiming at adjusted diameters to step1, resulting in average thickness
  - Produces internal sine wave design with smooth outer aluminum ring
- Measurements taken after machining process
  - Nikon Measuring Microscope measure length of band 0.500mm (FF), OD of the aluminum band (DD), and OD of the mandrel 0.884mm (EE)



Step 3: Epon Machining

Coating mandrel with Epon

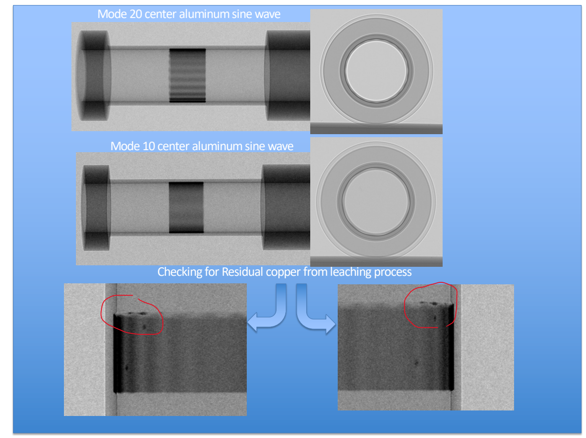
- Completely enclose mandrel and aluminum ring in Epon
- Let Epon cure for 72+ hours at room temperature
- Back-machine the overall design of the cylinder,
  - (OD of Epon adjusted per mandrel to OD of Aluminum)
- Measurements taken after epon is machined
  - Nikon Measuring Microscope used to measure epon thickness over the aluminum band (50um,GG), and overall length & OD of each cylinder section



Step 4: X-ray Radiographs

Final x-ray radiograph for validation

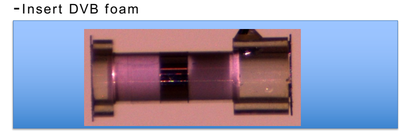
- X-ray radiographs of all targets
  - Validate Mode 10 & Mode 20 cylinders
  - Validate leaching operation is finished, check if any remaining copper material from the leaching process still hidden in pockets of sine waves



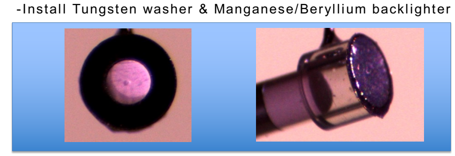
Step 5: Final Assembly

Putting it all together

-Insert DVB foam



-Install Tungsten washer & Manganese/Beryllium backlighter



-Install finished cylinder onto fiber/stalk