GENERAL ATOMICS

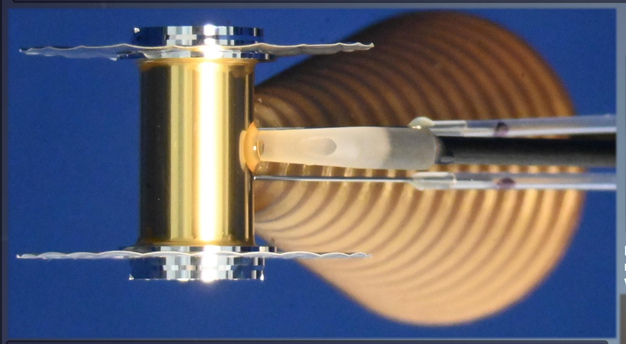
Evolution of Equation Of State (EOS) Targets Design and Assembly

T. Marcotte[1], N. Hash [2], C. Santos [2], M. Lament[2], J. Jensen[1]
[1]General Atomics, PO Box 85608, San Diego, CA 92186 [2]Lawrence Livermore National Laboratory, Livermore, CA 94550
This work performed under the auspices of the U.S. Department of Energy by General Atomics under Contract 89233119CNA000063 and by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344 **IFT/P2024-063** LLNL-POST-867015

The EOS (Equation Of State) targets provide a way to measure the basic properties of matter at the highest pressures possible in a repeatable way. Hundreds of materials have been measured using EOS targets. This platform provides a way to test and prove theories about materials essential to the study of many applied science programs at LLNL including white dwarf stars, black holes, and aging plutonium for the nuclear deterrent program.

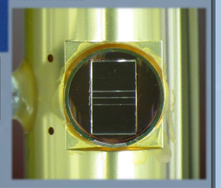
How it works

The EOS target consists of a gold hohlraum (HR) with Laser Entrance Holes (LEH) on the top and bottom. A Physics Package (PP) is located on the side at the base of a cone shaped shield. Each PP is mad up of a specific material or a specific set of materials.

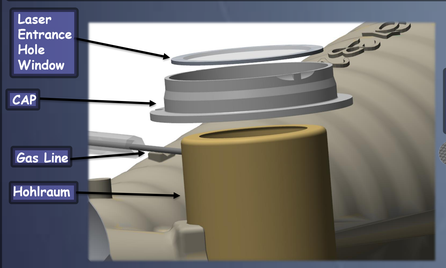


PP with 4 different samples

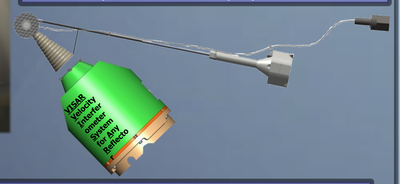
LIF PP on a HR 4 levels of material are separated by the white lines



During a shot NIF fires up to 172 laser beams through the LEH windows at the HR's inner walls to create a plasma explosion and a shock front that pushers on the PP.

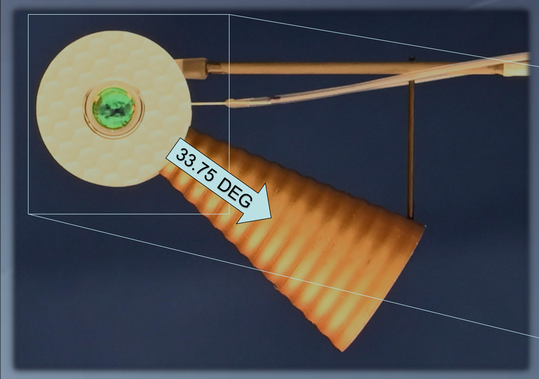


Using the Velocity Interferometer System for Any Reflector (VISAR) we are than able to measure specific material properties of the PP.

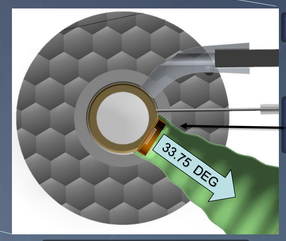


The NIF has shot over 160 EOS targets, providing accurate data on each of the materials tested. This information has proven extremely valuable to the science community.

Design Change



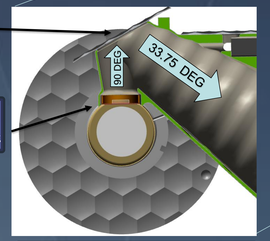
Design was changed adding a mirror to reduce debris in target chamber The remnants of the PP now hit a removable catcher



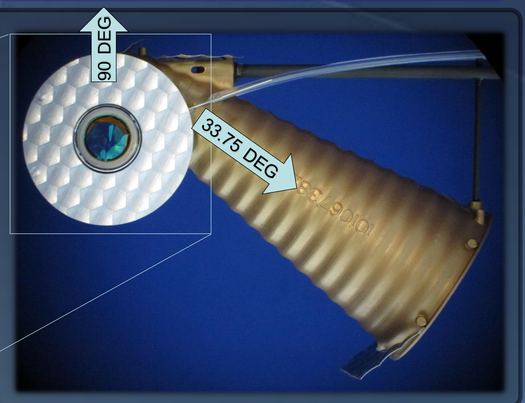
Mirror

Physics Package

Direct Line Of Sight

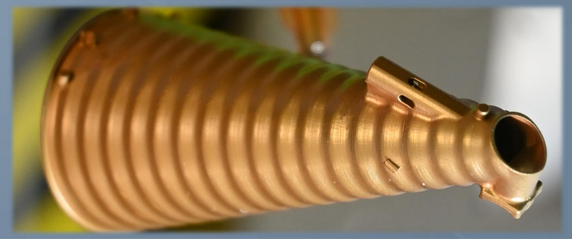


Reflected Line Of Sight

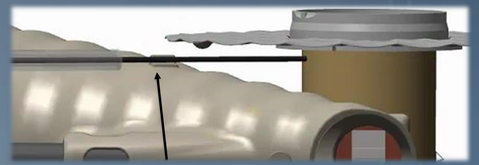


Cone was Modified to Improve Build Process

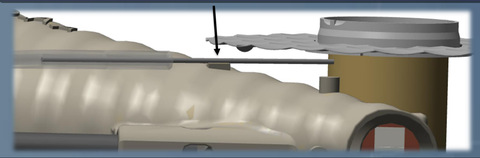
- In the previous warm EOS targets the cone was only used to shield the VISOR diagnostic from the lasers light.
- In the new design it's also Holds the mirror, anchors the Stainless-steel tubes, and bridges the hohlraum to the base.

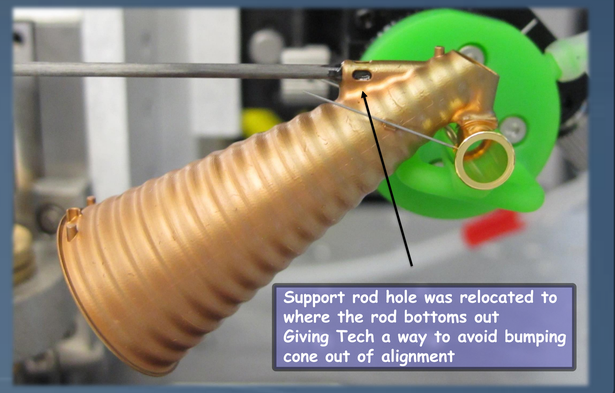


After the first build of this new design, we made some changes to speed up the assembly process.



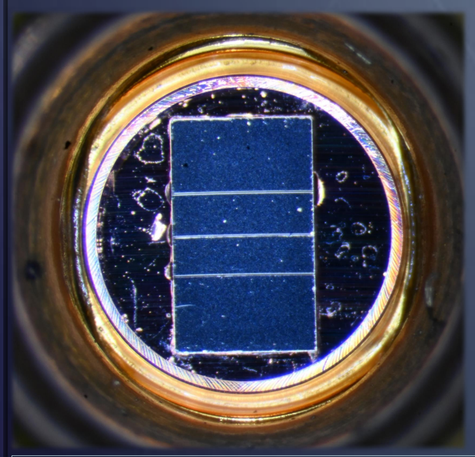
The anchor points for the Stainless-Steel Tubes (SST) was an L shape. This proved difficult to work with and was changed to a flat spot saving time on each assembly.





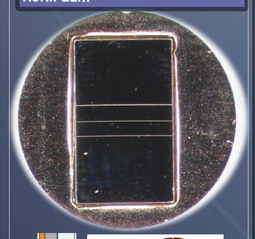
Support rod hole was relocated to where the rod bottoms out
Giving Tech a way to avoid bumping cone out of alignment

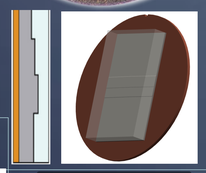
The Physics Packages (PP)



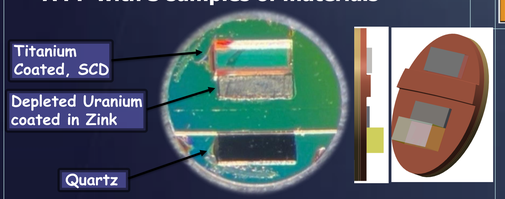
A Titanium LiF PP

This PP is machined with 4 steps. The VISAR masseurs the Velocity of each step as they travel away from the hohlraum





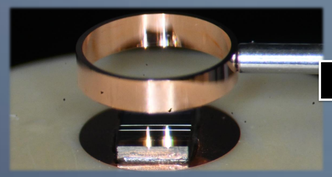
A PP with 3 samples of materials



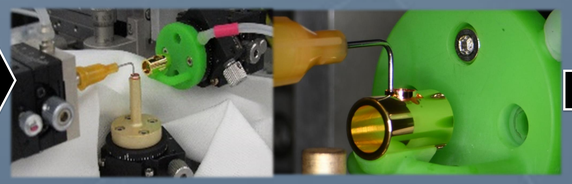
PP next to A Dime

Build Sequence

A small coper wall is Glued around Physics Package to help shield light

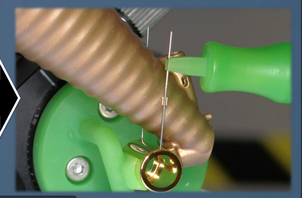


The Physics Package is installed to Hohlraum Alignment is critical



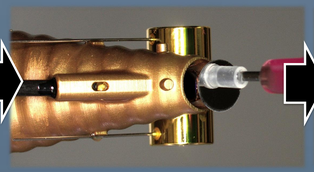
Cone is installed to Hohlraum

Stainless Seal tubing is installed to Hohlraum

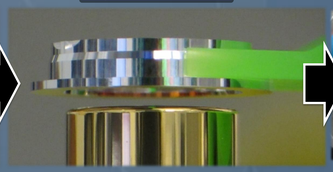


Base is inserted into Cone

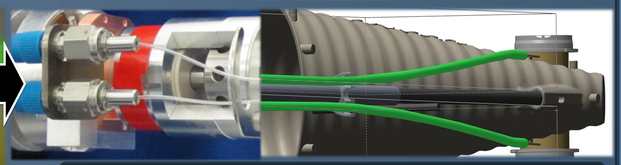
Mirror is installed



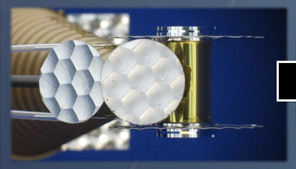
Caps are installed



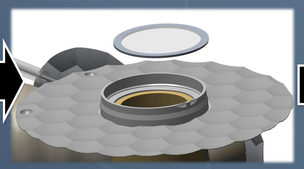
Gas lines are installed



Shields are installed



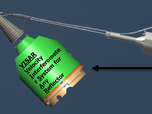
Laser Entrance Hole (LEH) windows are installed



Completed Target

Fun Facts

- Most EOS builds can be completed by 1 Tech in less then 2 weeks.
- The hohlraum is pressurized with neopentane gas. This helps slow the expansion of the walls during ablation.
- Some EOS shots will drive the lasers for up to 30ns.



The VISAR is the main diagnostic for the EOS
It tracks the velocity of the PP, or different parts of the PP, as it travels away from the HR during a shot.