ICF Target Support Highlights

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General Atomics, with our partner Schafer Corporation, serves as the ICF Target Support Contractor, providing target development and fabrication and target system engineering development to support the ICF program at five ICF Labs – LLNL, LANL, NRL, SNL, and UR/LLE. This informal newsletter contains highlights of that support for January 1999.

GA/Schafer onsite staff at LLNL, LANL, and SNL fabricated, machined, assembled and characterized more than 135 targets of various kinds for experiments on Nova, Omega, Trident, and Z. We fabricated, characterized, and delivered more than 350 targets and target components, including micromachined hohlraums, witness plates, and foams to LLNL, LANL, and SNL for shots on Nova, Omega, and Z, plastic and glass microballoon capsules to LLNL, LANL, and UR/LLE for shots on Nova and Omega, and flat foil targets of various materials and configurations to NRL and UR/LLE for experiments on Nike and Omega.

Fig. 1: Shroud puller system with GA Lead Engineer Ken Boline

As part of the Omega Cryogenic Target System, a mobile cryostat provides cooling for a cryogenic target while it is transported from the DT fill system and placed inside the Omega target chamber. A cooling shroud surrounds the target and maintains the required 18K temperature. The shroud must be removed before the laser shot so that the beams have unobstructed access to the target. When the shroud is removed, the target heats rapidly and will burst within about 100 ms.

To satisfy the thermal and optical design requirements, all shroud parts must be retracted at least 20 cm away from the target during the 50 ms preceding the laser shot. When the shroud is removed, vibrations must not be transmitted to the target. The shroud's acceleration and velocity profile must be precisely controlled during the retraction process to avoid imparting a shock load to the shroud prior to liftoff, or to the Omega target chamber. After the laser shot, the shroud must be replaced onto the moving cryostat in exactly the same location and orientation.

To accomplish this very challenging task, GA and LLE personnel designed and built a shroud gripping and pulling system that removes the shroud vertically toward the top of the target chamber. Figures 1 and 2 show the unit mounted in a test facility during recent operational tests. The shroud puller consists of a large linear motor, vacuum feed-through section, gripping system, housing structure, and control system. The linear motor is located outside the target chamber so that it can operate in atmospheric conditions and to facilitate maintenance.

Figure 1 shows the housing structure with the vacuum feed-through attached under it. The linear motor is mounted inside the white housing. The motor accelerates 100 kg (220 lb) of moving components to maximum speed and returns to stop in a very short 0.9 m (31 in.). It is operated under closed loop control during the entire process. Figure 2 shows the gripper guide tube extending downward from the vacuum feed-through toward a cooling shroud. A 2.5 cm (1 in.) diam. rod connects the gripper to the motor carriage. This rod passes through the vacuum feed-through, and a dynamic seal is maintained via dual differentially pumped O-rings. The gripper is designed to grab and release the top of the cooling shroud. It is compliant at the start of the gripping process. A stepper motor cinches the gripper's parts together and secures its attachment to the shroud.

During recent operational tests at GA, the motor reached 4.4 m/s peak velocity and 3 g's peak acceleration. The gripper maintained a solid grip throughout each high speed retraction event. In addition, no permanent lateral displacement of the cooling shroud occurred, and it was successfully reseated onto locating pins after each high speed run.

Fig. 2: Gripper guide tube

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