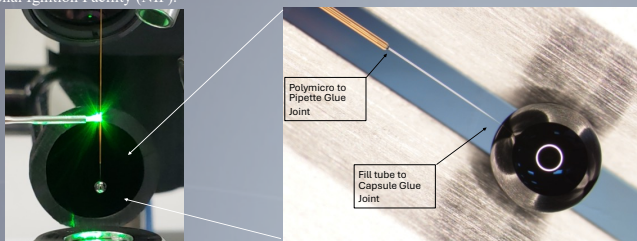




## TESTING OVERVIEW

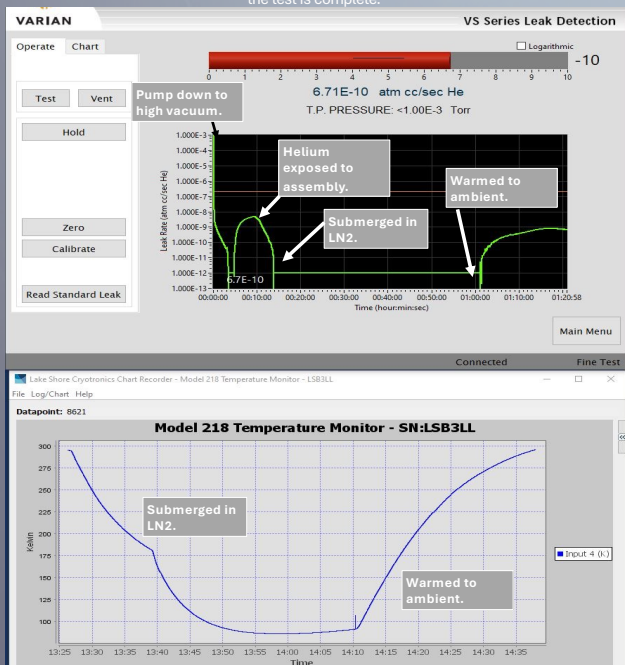
Helium mass spectrometer leak detectors provide the most accurate and reliable means of locating and measuring leaks in systems and products. In support of Inertial Confinement Fusion (ICF) campaigns General Atomics strives to use leak detection techniques to provide the high-resolution data on capsule fill tube assemblies (CFTA) to understand if they are ready to integrate into experiments at the National Ignition Facility (NIF).



Purpose: By incorporating these tests into the assembly process, we can reduce time-to-market for historically time-consuming target builds. This data can be used to give us feedback on new assembly designs, capsule coating methods, and allows us to troubleshoot and repair multipart assemblies.

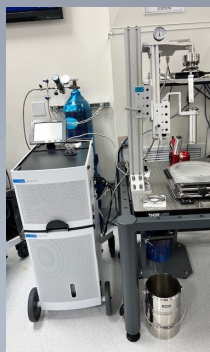
## TESTING RESULTS

During this test, The helium signal is monitored and measured. Helium is introduced at a specific pressure and time. Once helium signal stabilizes, the vessel is submerged into LN<sub>2</sub> and held for one hour. After one hour, it is removed and warmed back to ambient. At ambient conditions, the signal should return, and the test is complete.



## TESTING SETUP

### Full System Overview



### CFTA Mounted for Test



### Ambient Test



### Cryo Test



### End Test



- The Helium leak test uses VCR fittings to reach high levels of vacuum.
- Custom fixturing has been designed to safely move assemblies throughout the process.

- The CFTA is mounted vertically, then enclosed in a sealed vessel.
- Once sealed, the leak detector is turned on and begins to pump down the assembly.

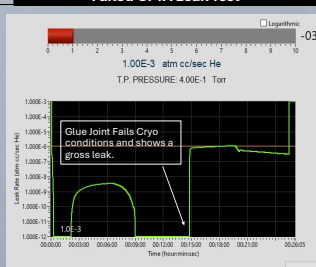
- After the assembly reaches high vacuum, Helium is exposed into the vessel at a measured rate.
- The Helium leak rate is captured once the signal stabilizes.

- After Helium is detected, the assembly vessel is submerged in LN<sub>2</sub>.
- This is a quality check to ensure the assembly can survive test conditions for LLNL.

- The assembly is required to survive cryo conditions for a prescribed duration of time.
- Once this time is met, the assembly is removed from LN<sub>2</sub> and warmed back to ambient conditions.
- At Ambient conditions, Helium signal should be seen again.

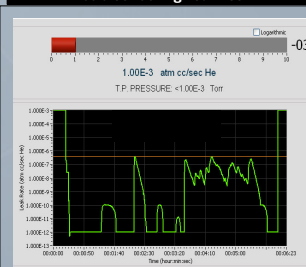
## TESTING CHALLENGES

### Failed CFTA Leak Test



- During assembly, complications can occur. The chart above shows that the assembly under test Failed.
- The assembly was able to show a traditional value at ambient temperature.
- But when cooled with LN<sub>2</sub> to the customers specification, the assembly was only able to survive a short period of time before showing a gross leak.
- This indicates a glue bond failure somewhere in the assembly.

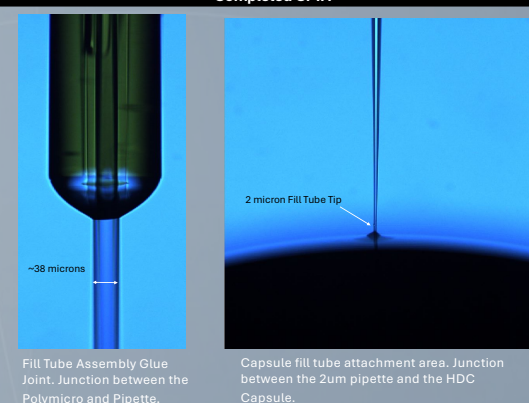
### Troubleshooting Leak Test



- Once a leak is detected, we can manipulate our system to help us understand where the leak is taking place.
- To troubleshoot, we remove the CFTA from the vessel and purge the area of Helium.
- Once the assembly has pumped back down to high vacuum, we can expose the assembly to a localized helium spray.
- With a fine point nozzle, we can use controlled bursts of helium at each junction on a CFTA.

## RESULTS

### Completed CFTA



- With Helium leak testing, we can prove our glue joints are hermetically sealed and of the highest quality for our customer.
- With the implementation of this test, we can prove our assembly will not leak during customer set up.

### What's Next?

Moving forward, we will continue to work with our customer to ensure their expectations are met and align our practices to ensure the highest quality product available.