HXRSD Helium Enclosure Purity and Components

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Introduction

This project involved putting a Helium enclosure around the X-Ray laser and seeing where there would be any effects of leaking. The main part of this summer project was the assembly of the enclosure with subsequent parts added to the main granite table that was present. Parts included various Aerotech pieces and 3D printed parts that mounted on the granite table. In addition a gantry system had to be designed and built in order to mount a camera and an autocollimator.

Research

My first task that I was assigned was to assemble parts of the helium enclosure. Part of this process was to make sure that pieces were as insulated as possible when they were mounted on the granite table. This was done through the use of various, specific screws, rubber gaskets, and a thick layer of caulk between the joints.

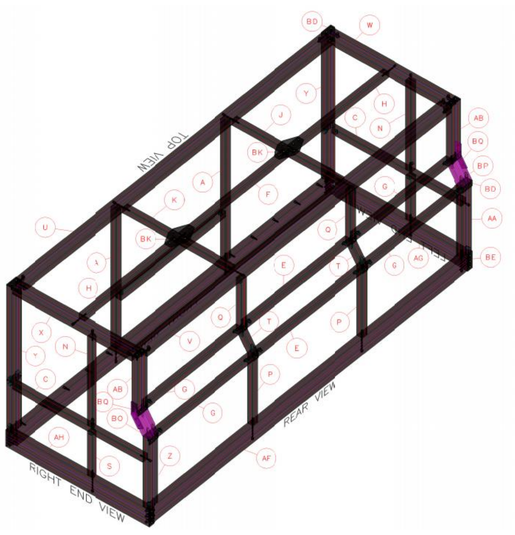
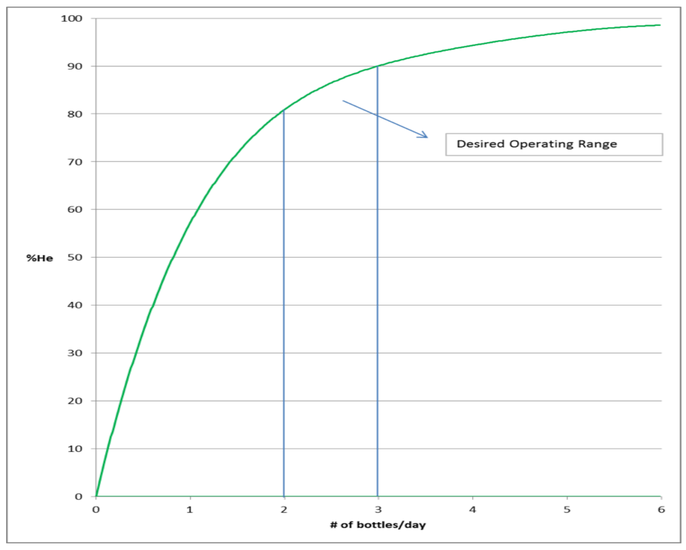


Fig 1. Complete He Enclosure, Currently assembling and mounting in parts

We needed to keep the leakage of Helium to be as minimal as possible in order to ensure that the experiments that were going to be conducted were to be exact.

Previous experimentation by co-workers Justin James and Hongliang Shi found that more leakage at the bottom of the enclosure rather at the top, then there would be greater Helium purity for less usage. Once the He purity at the bottom of the enclosure is greater than 50% then too much He is being leaked, therefore, the top should be sealed better.



Source: Hongliang Shi

Fig 2. This graph shows the the operating range that our team was trying to achieve.

My second task was to design and build a gantry system that would be mounted onto the granite table. The gantry would be use to mount a camera to capture results and an autocollimator. The gantry system had to be able to more forwards and backwards.

The actual mount component had to move forwards, backwards, up, down, left, and right. This was initially built and tested in the metrology lab with the use of the granite table that was available there. From there adjustments were made so that the gantry system could be made to the desired specifications.

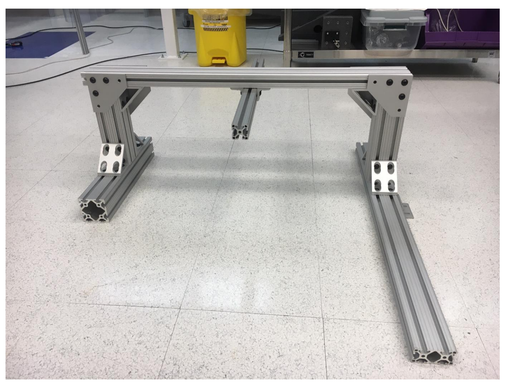


Fig 3 Front View of Gantry Mount showing it can move forwards and backwards

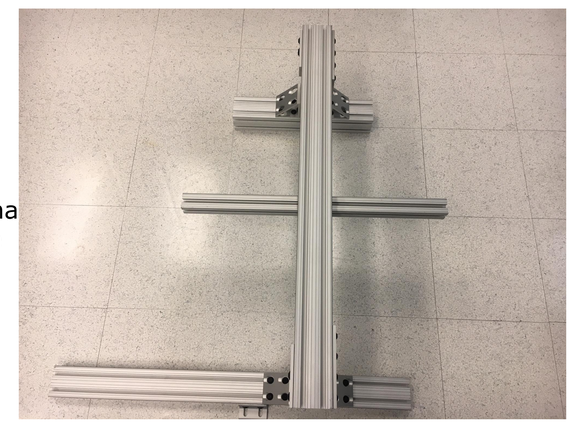


Fig 4. Top View of Gantry Mount. Camera and autocollimator will be mounted.

Throughout the process I also 3D printed various components that went onto the granite table. The parts that I printed were either finial components that went onto the table or were part of components that were then put onto the table.

Part of the process involved me getting instructions of what parts should look like, modeling them in SolidEdge and then printing them. Once I had the parts I went to test to see if they fit the specifications that were needed. If not I would go back and fix the model. For other situations I was simply given the model number and simply just had to print out the part.

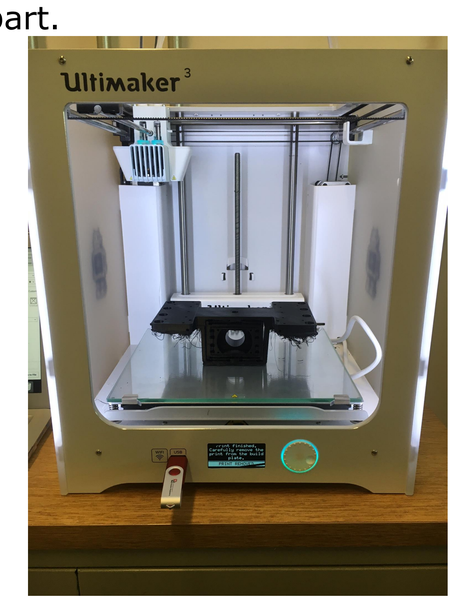


Fig 5. Here is the Ultimaker 3 which was used to 3D print components. It is shown printing a flexure part that will go on to the granite table. Printing could take anywhere form hours to days.

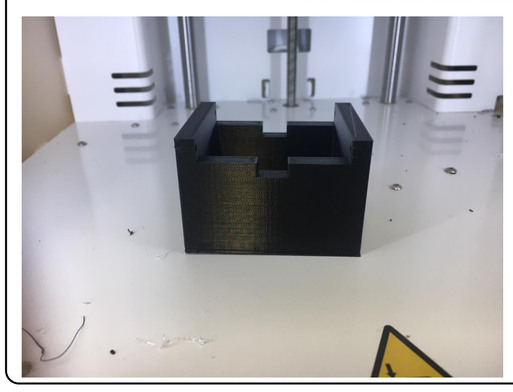


Fig 6. One of many caps that will cover a crystal that will sit on the granite table.

Conclusions

Although this project is still ongoing, we have found many nuances in the design and assembly process that made things interesting. One thing is that most of the leakage would be from that various patch panels that were mounted on the He enclosure. Another thing we found is that some parts had manufacturing defects; meaning we had to adjust by either machining correct holes or using different types of screws.

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