3D Printed Tool

International Space Education Institute

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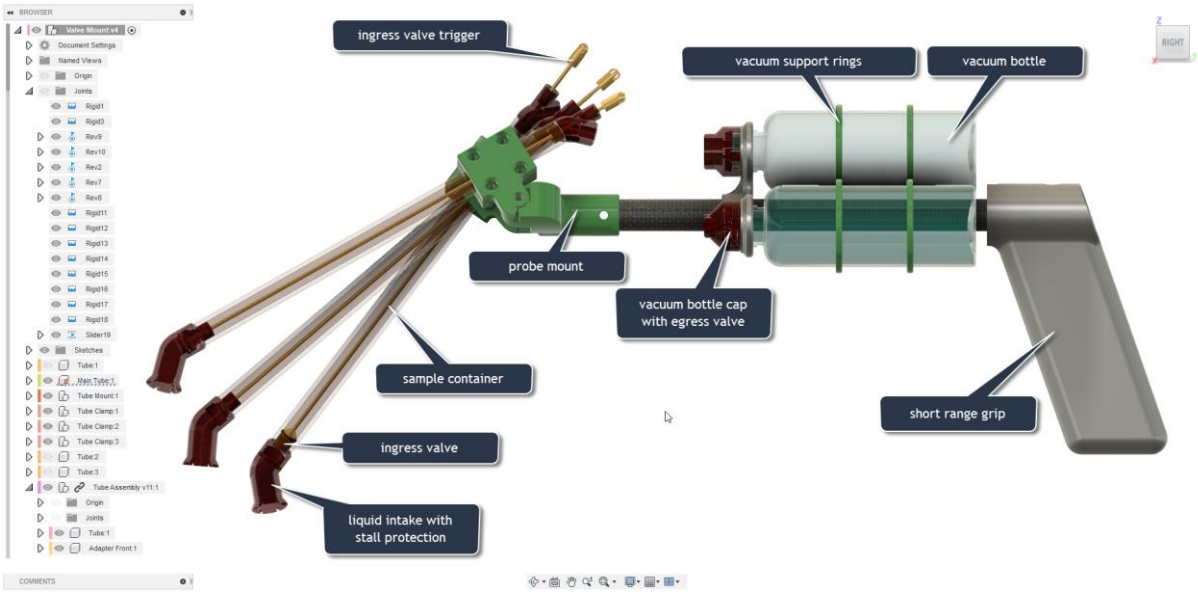


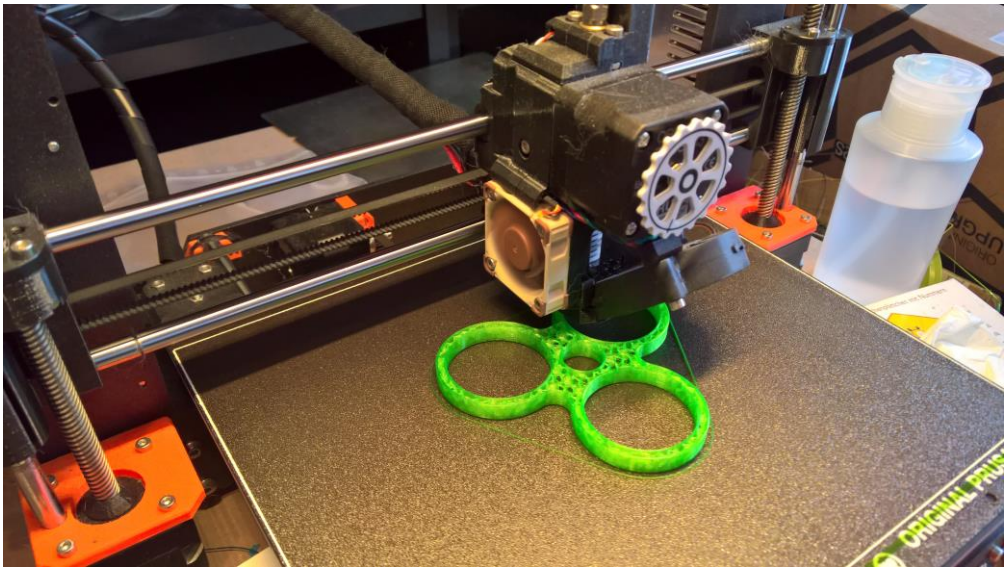
Contents

Parts that were used during the developpement

1: The task

Our task was to improve our previous design we used for the liquid sample task in the race of 2019. Our last iteration consisted of three syringes that could pump up the liquid by releasing the vacuum we had previously added into the syringes by loading the syringes but stopping the air from getting out again by blocking the exit with a valve. For the valve, we used a cap made of stretchable leather. Although it could serve its purpose under perfect conditions, it was very trigger happy and during the race and two of the three valves opened themselves, ejecting all the fluid that had already been stored inside of it. Even though this happened, we were one of the best teams for this task. The mounts for the syringes weren´t made well enough for us, they only consisted of hot glue, which held the iron bar and the syringes together. We thought that all these problems could be solved with 3D printed parts. We used the free program CAD Fusion-360 to design our CAD-files and printed our parts with the help of our FDM printer Prusa I3MK3S and our MSLA printer Prusa SL1. We used PETG filament for our green parts and ELEGOO-Clear red polymer resin for our red parts. The PETG gives us a great stability for our parts, which makes it a perfect filament for our project. The CAD-Files are exported as STL-Files into the Prusa slicer, which calculates the G-Code for the 3D-printer.

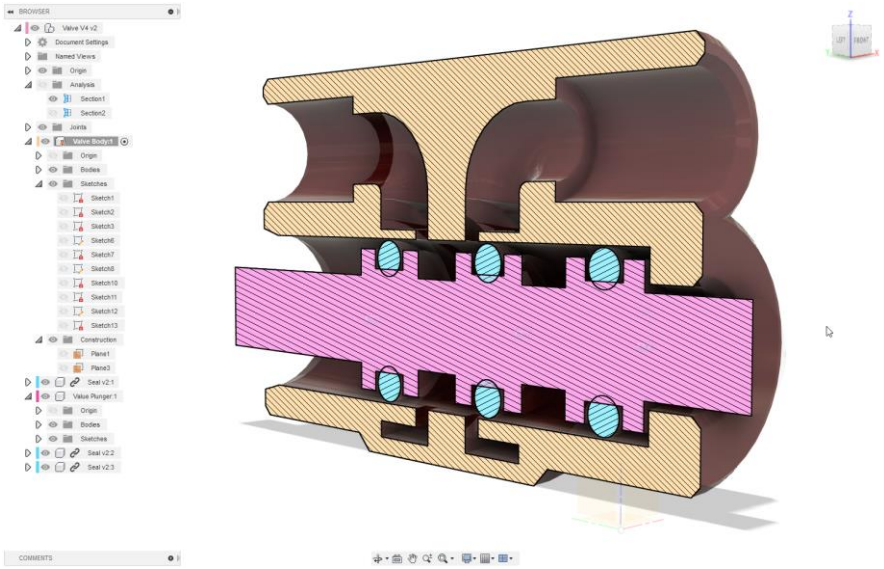
Note: In the further documentation, the tool that was made is being referred to as “Liquid Buster”



Printing process of an earlier mount

Old design for the liquid buster:

Old design: In this design, we used the syringes to create the vacuum. A basic valve kept the vacuum inside of the syringes, making it a working prototype for the race. We wanted to reduce the weight of its all and improve the valves, which didn´t work as planned, so we created a new version, using a few of the older ideas. By using light plastic containers as a vacuum storage instead of the syringes, we were able to save about half of the previous weight, which was a huge improvement.

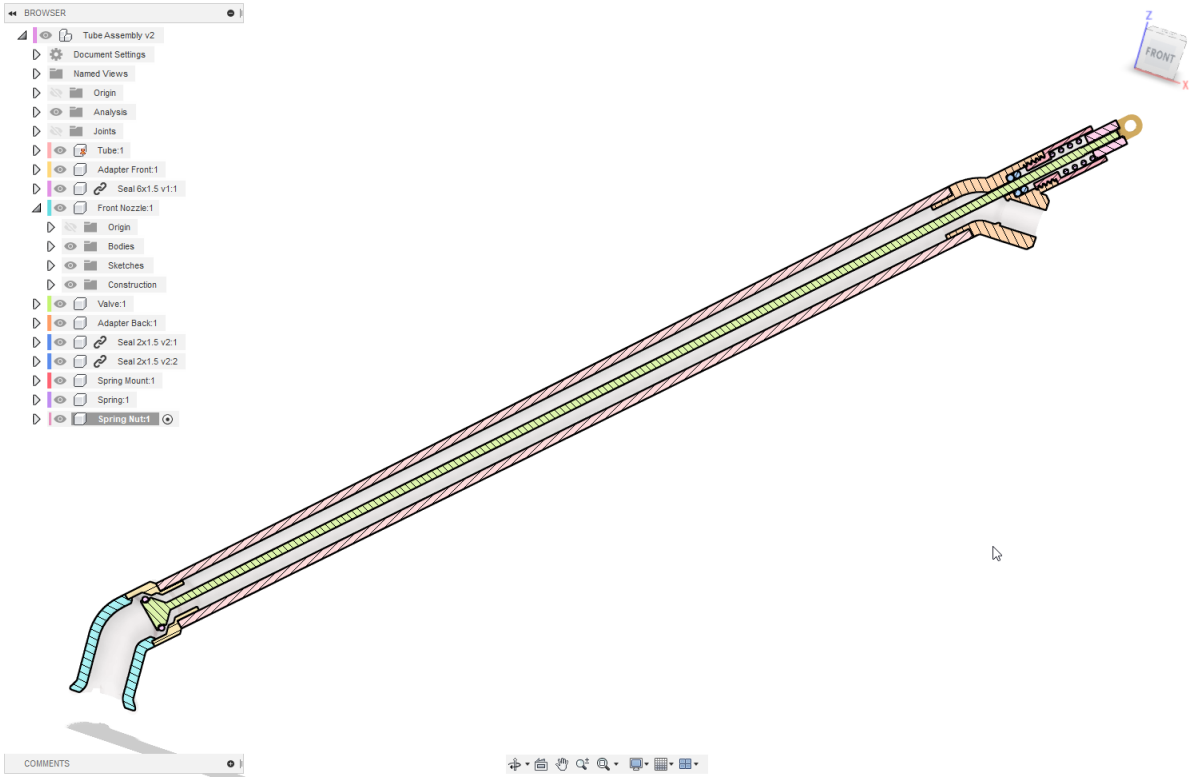


Old valve: Through the rod in the middle, on which sealing rings are applied, it is possible to open and closing the valve by pulling or pushing the rod, connection and disconnecting the two pipes from each other, leading to air being able to go through. The main problem was that the rod sat too tight, making the opening sequence tedious and difficult.

Our new, 3D printed version

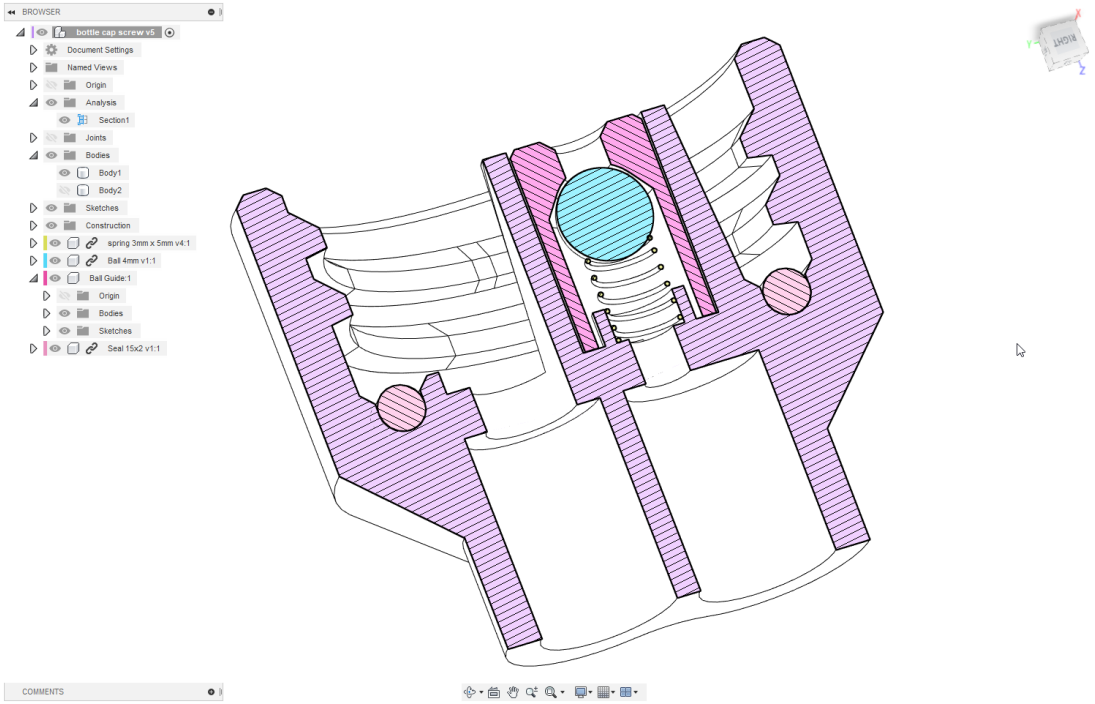
Parts

Our new version of the liquid buster consists of two main parts: The valve mount and the valve, which serve as a container for our liquid probes and prohibit the loss of our built-up under-pressure as well as suck up the liquids. It also consists of the under-pressure containment mounts, which hold the containers in place. For the containers and the valves, we have had multiple constructions that all work, but we are showing our latest one.



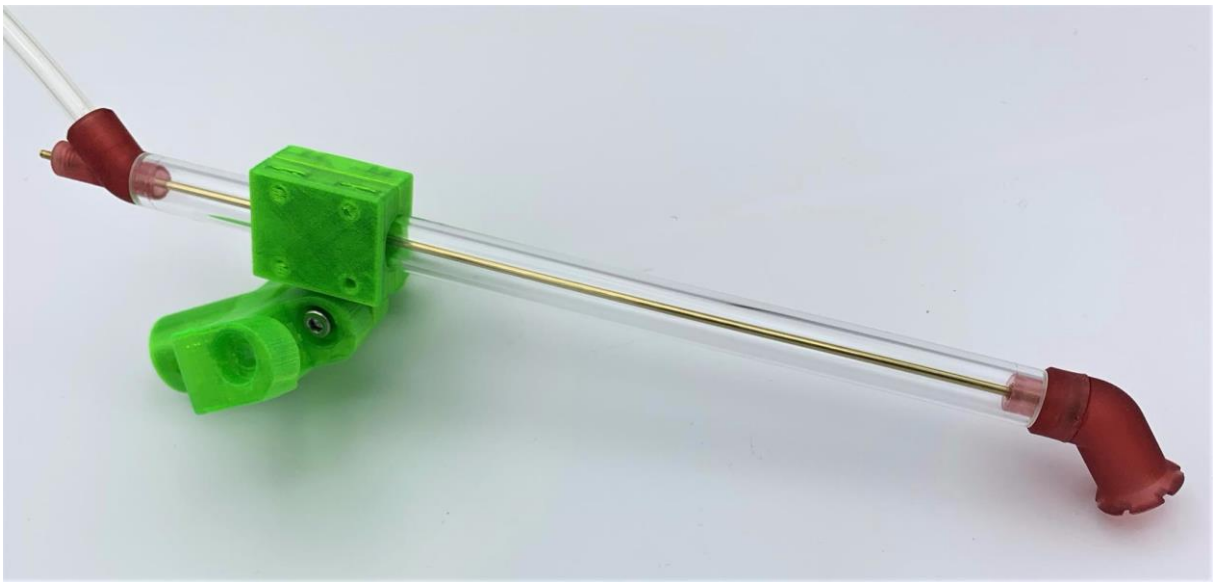
Side view of Liquid Buster: This picture shows a side view of our valve, which we are going to use during the race. In the bottom left one can see the valve, which is attached via an aluminium pipe to the activation mechanism in the top right. Going to the right, there is an exit in the pipe leading to the vacuum containers. Liquids are sucked up the plastic pipe, which isn´t 3D printed and flow toward the containers. The activation mechanism works due to the spring, which closes the valve again after activation by wanting to stretch, causing the valve to be pushed back again, closing exit, keeping the liquid inside the containers

Valves: Here you can see the design for the mount, which lets us carry three sample containers, one for each sample.

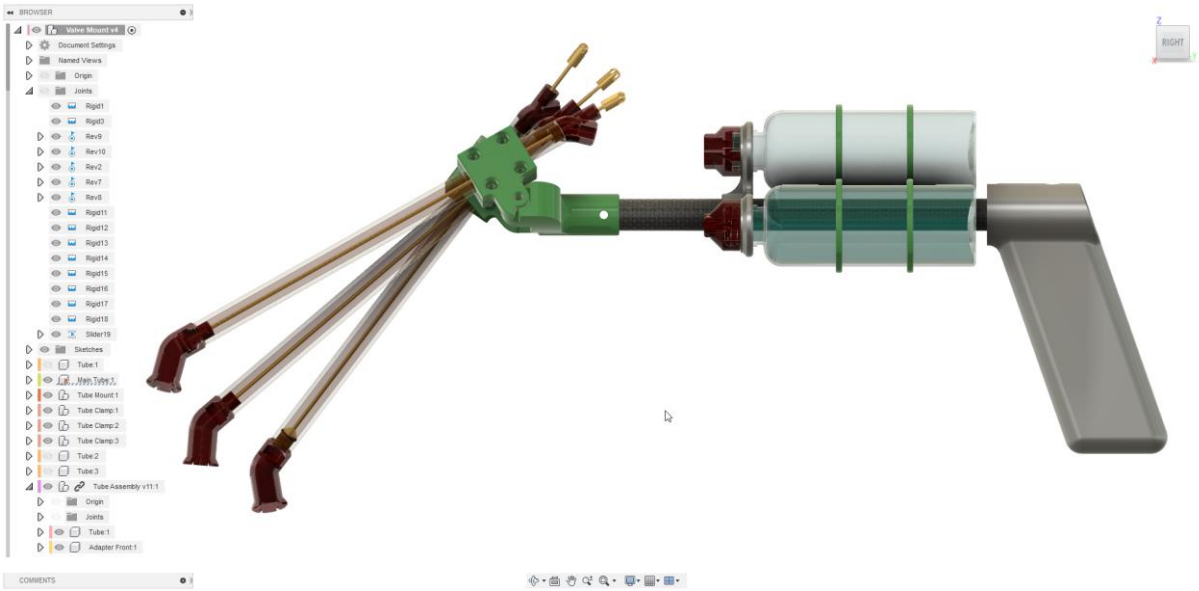


Valve design for containers: This is for the vacuum container of the liquid buster. Its function is to create a vacuum. With a vacuum pump we extract the air out of the enclosed system, creating the mentioned vacuum. The spring prohibits any air from getting in, creating a seal to secure the enclosed system

Bottle for vacuum containment



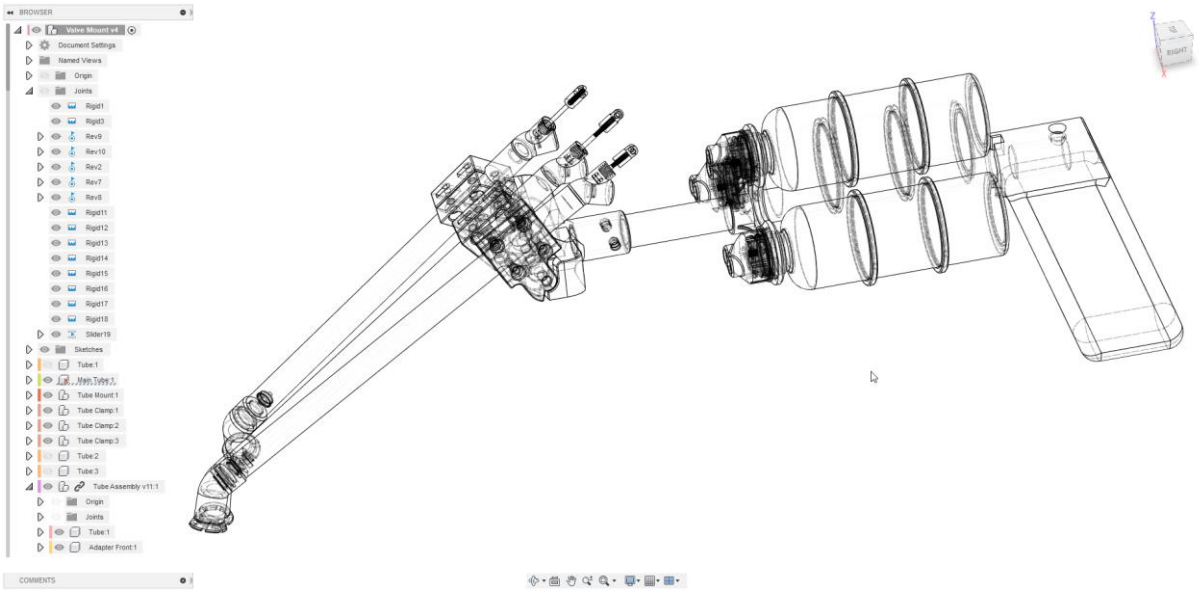
Single valve printed: One of the three mounts with all the finished 3D printed parts. On the right you can see the end of the Liquid Buster, which is held into the liquid to later extract some of it. Little slots are in between the end to protect the valve from being sucked onto the edge of the fluid sample container, which would waste a lot of the vacuum and would be harder to remove due to suction



Side view of Liquid Buster: This is a CAD-Rendered picture of the Liquid Buster. This image introduces the grip of the liquid buster, which is used by the driver to hold and wield the tool.

Top view of final product: All Liquid Buster parts are connected to a carbon pipe

Isometric view of final product



Wireframe of final product

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