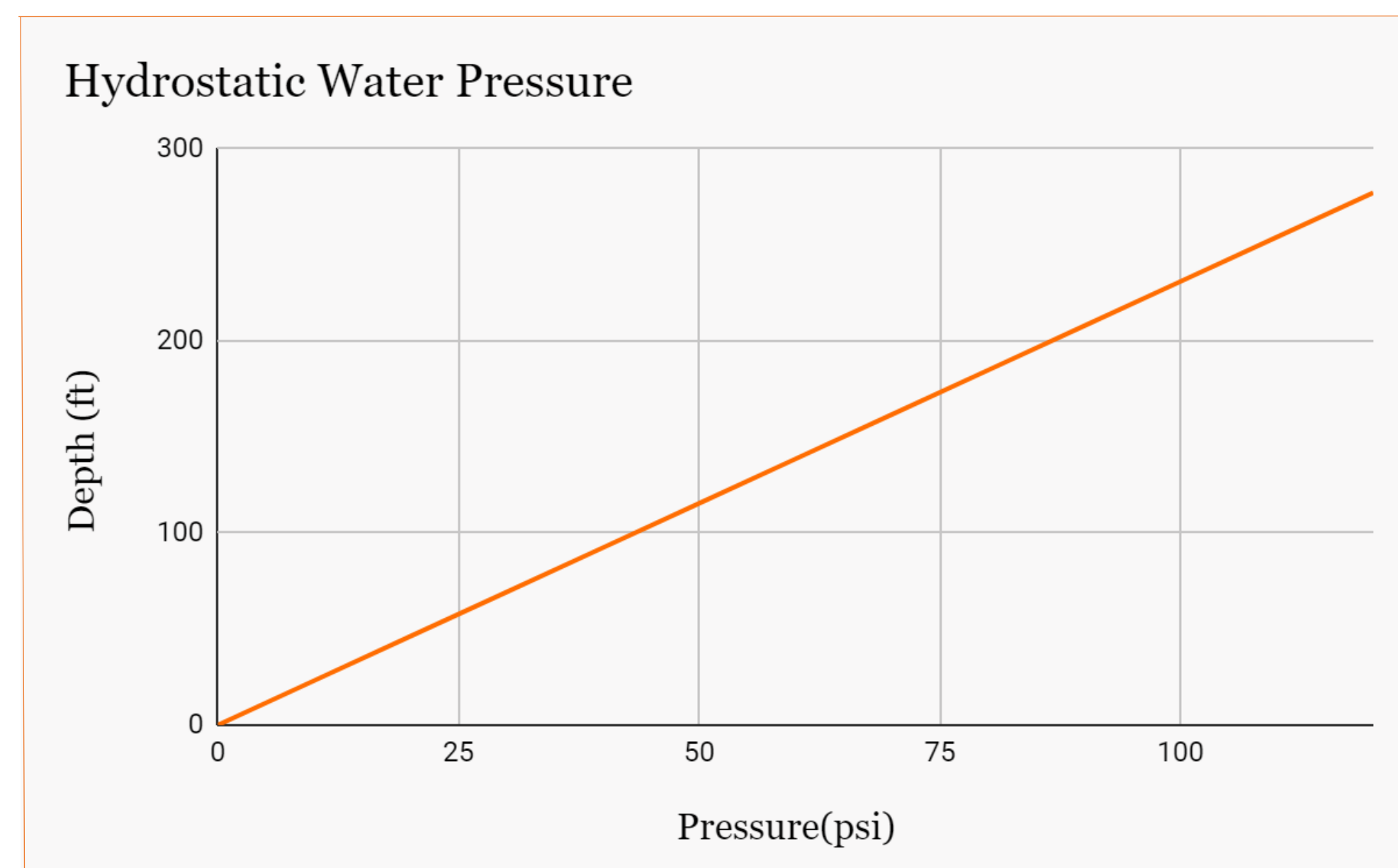


What does it do?

Understanding Hydrostatic Pressure:

- The pressure exerted by a fluid(water), due to the force of gravity.
- Hydrostatic pressure increases in proportion to depth measured from the surface because of the increasing weight of fluid exerting downward force from above.



The Vessel:

- The goal of the vessel is to mimic that pressure in a controlled environment.
- It must also be able to open for test subject and be able to seal for containing the pressure. All while being reusable and relatively easy to operate.
- The Innovation Lab already has access to 120 psi compressed air, so the vessel must be able to withstand that pressure without breaking or leaking pressure.
- It must also be able to manipulate that pressure and change to a desired psi.

Why?

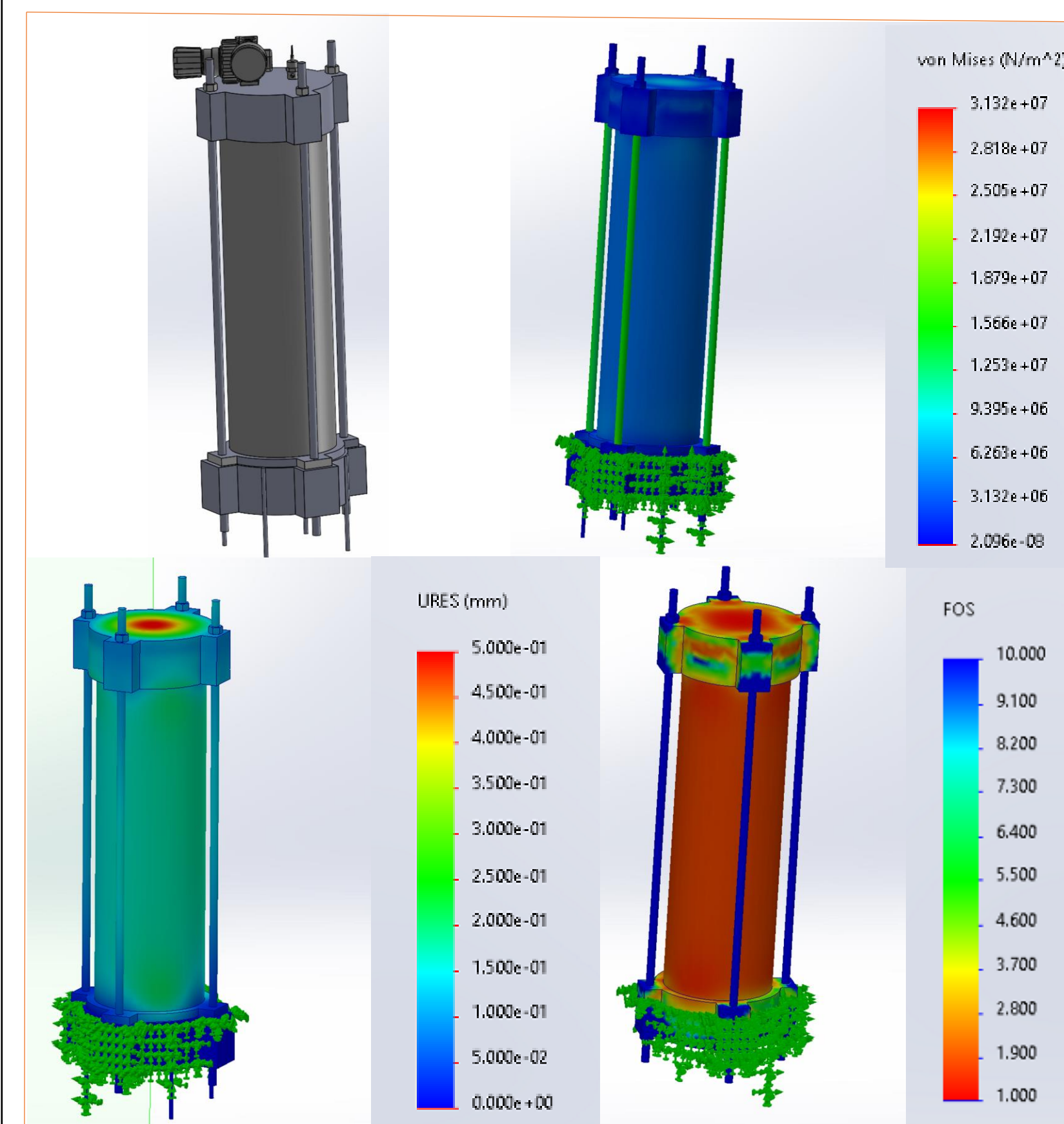
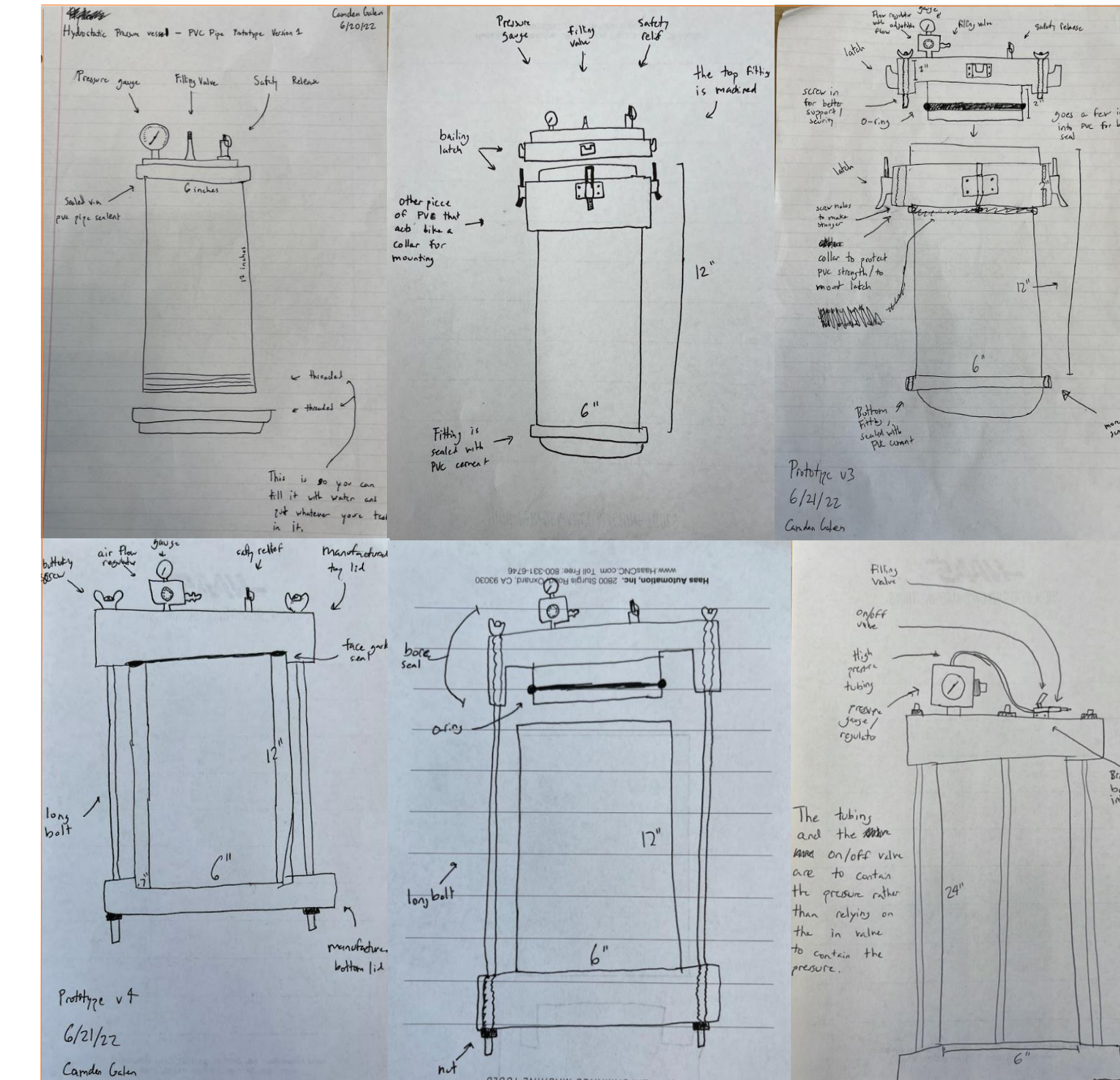
Expansion of Testing:

- The Innovation Lab get's a lot of marine based projects and deep-water housings brought to it. Currently the only way to test those projects, is to go out on a boat, and test their projects in the ocean.
- This is multiple issues which the Hydrostatic Pressure Vessel can solve:
 - Low cost and on sight. No need to go out on a boat and use a whole day to test items. Instead, they can test how their project will react, here in the lab.
 - It is in a controlled environment. If the project is only going to go 100 feet under water, the vessel can be tuned to exactly the correct amount of pressure necessary to mimic 100 feet.

My Approach

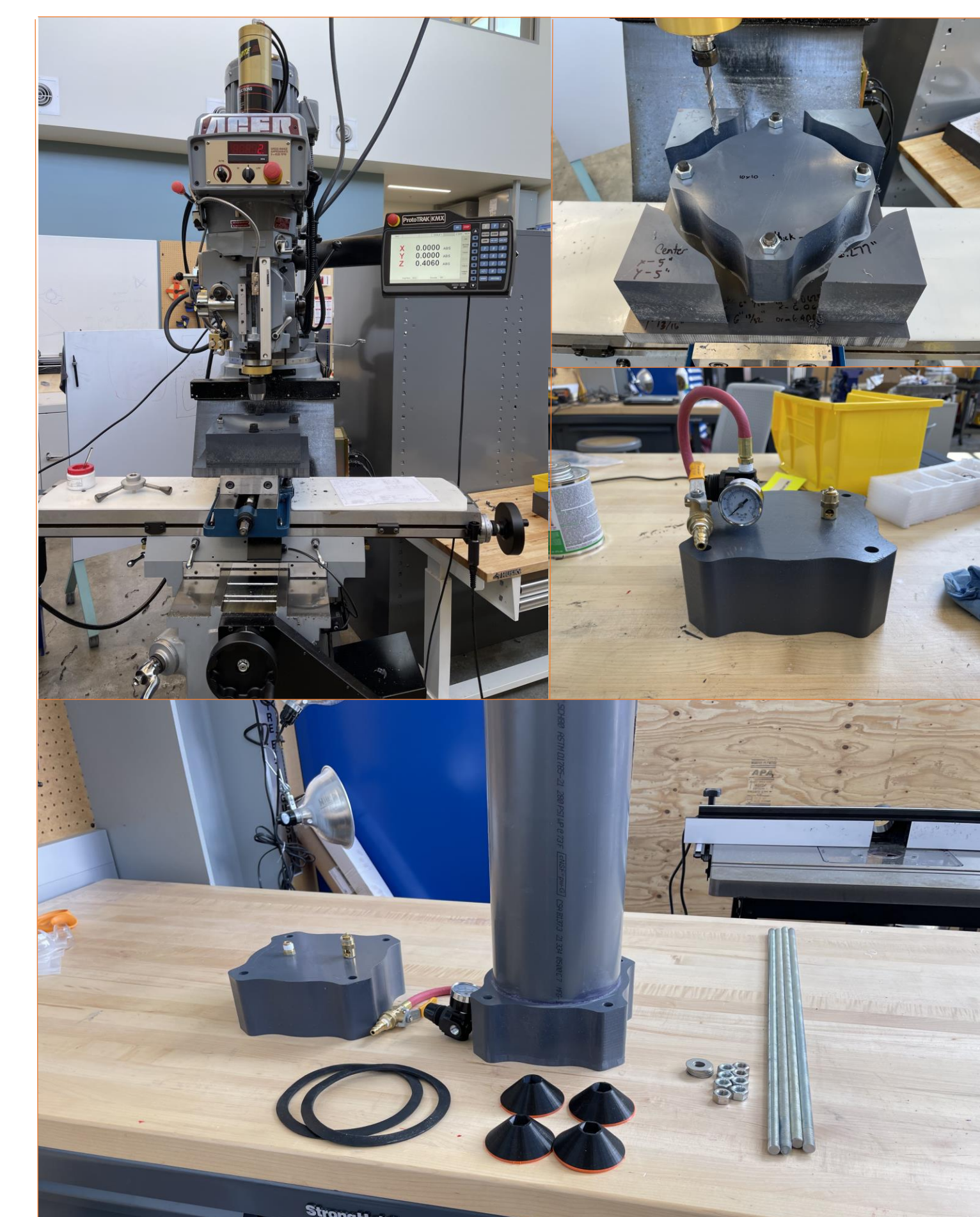
Progression of Planning a Design:

- The design was always surrounding a 6" schedule 80 PVC pipe and with a maximum capacity of 120 psi in the vessel.
- The issue at hand was solving a way to create a removable top cap, so it can be repetitively tested.
- Design progressed from a threaded cap to the final design (bottom right) where it is mounted with 4 threaded rods.
- The seal is created in the top face of the PVC and the bottom face of the end cap, with a rubber gasket in-between



3D-modeling/Simulating:

- On SolidWorks I created a model of my design and simulated 120 psi.
- Stress – is on the threaded rods, which is where we want the stress.
- Displacement – is on the top fitting which is accurate, because that is what is holding in the pressure.
- Factor of Safety – the number of times over the plastic can withstand 120 psi. The whole body in the sim is 1.0, which is bad, but the 6" schedule 80 PVC is rated to 280 psi. So, the body is over 2 times stronger than we will testing it at.



CNC Milling:

- I converted the 3D model to a CAM(computer-aided manufacturing) file, which allowed me to mount a 10"x10"x3" piece of PVC stock, mill out the outline, and the center pocket.
- I did this process twice, one for each end cap. For the top cap I drilled and tapped two holes, one for the regulator and one for the safety relief.
- This process taught me a lot, I had little experience 3D modeling, converting to CAM and CNC milling, but after this experience I have learned a lot about the manufacturing process.

Results

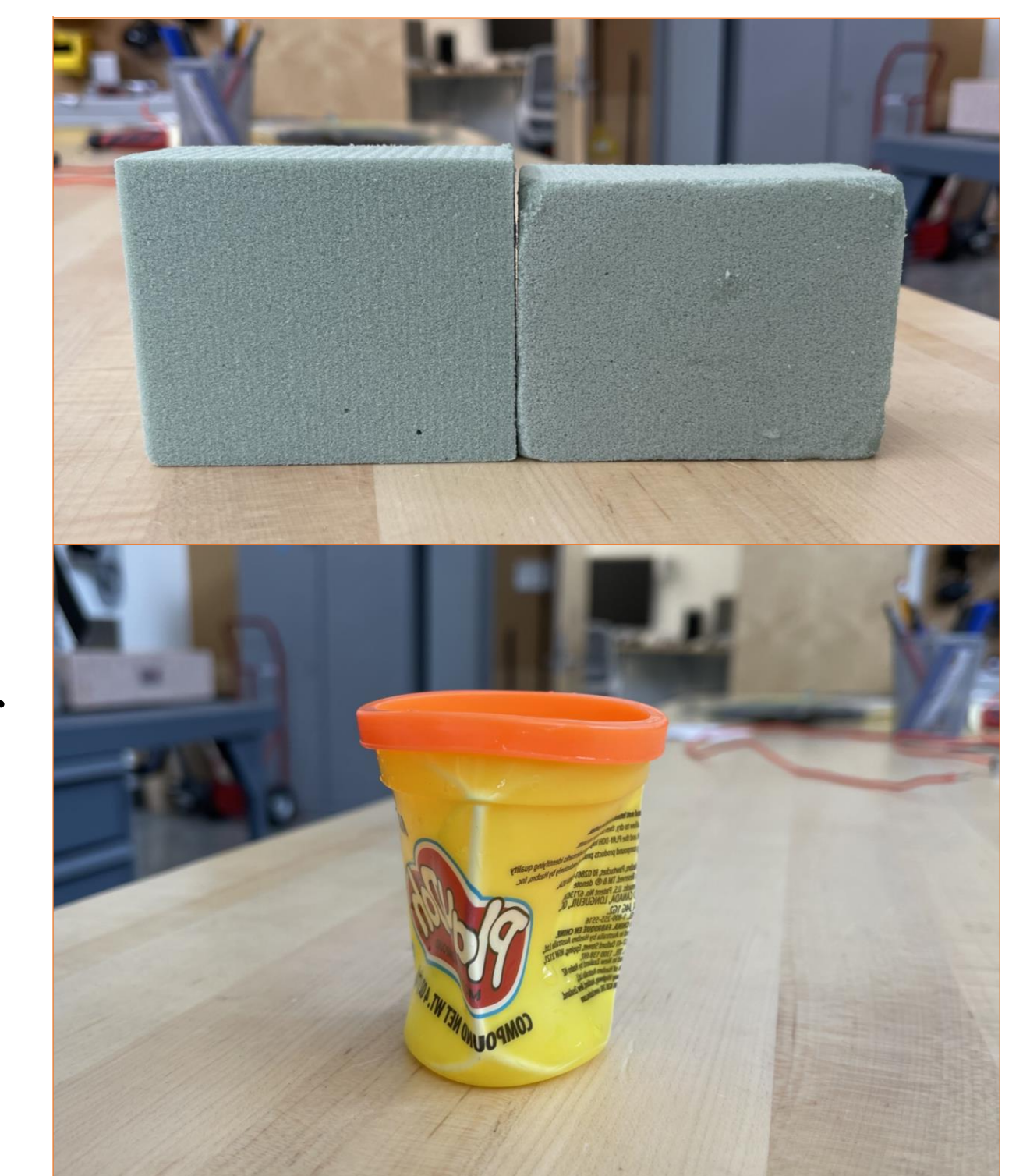


Final design:

- 2'x6" schedule 80 PVC pipe
- 2 manufactured end caps
- Pressure regulator and gauge, 1' tube, on/off valve, safety relief(150 psi)
- 1 rubber gasket
- 4, 30" 1/2-13 stainless steel threaded rods
- 12 stainless steel nuts, 8 stainless steel washers
- 12"x12" stainless steel base plate
- 4, 4" 3/8-16 leveling feet

Testing:

- To the right is foam, the one on the left is the control, and on the right underwent 110 psi.
- Underneath that photo is a Play-Doh container that was crushed under 100 psi.
- Both reacted how expected, foam shrunk, and the Play-Doh caved in.



Ready for real use:

- The tests proved that the vessel works.
- The vessel is prepared to be used for any project that may come to the iLab

Learning:

- Over the course of this summer internship, I learned a lot. I got to learn a little bit about everything. As well I got to focus more on CNC milling, and the manufacturing process.
- Some of where I learned the most was when issues or failures came up. I got to problem solve to understand why that failed, and what to do to prevent that. I'm very thankful for this opportunity and how much I learned.