VEX Robotics Make It Real Online Challenge
Sponsored by Autodesk

Air Reservoir Mount

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Introduction:

The 2021-2022 VEX Robotics Competition Tipping Point added a new rule that allowed for pneumatics to be used alongside eight motors. Previous years barred that from happening by requiring teams to sacrifice some motors for pneumatic usage. Since VEX itself doesn't sell mounts for the reservoirs, we decided to design one ourselves. This design is simple and easy to implement onto a robot and solves the problem of inconsistent methods of holding reservoirs.

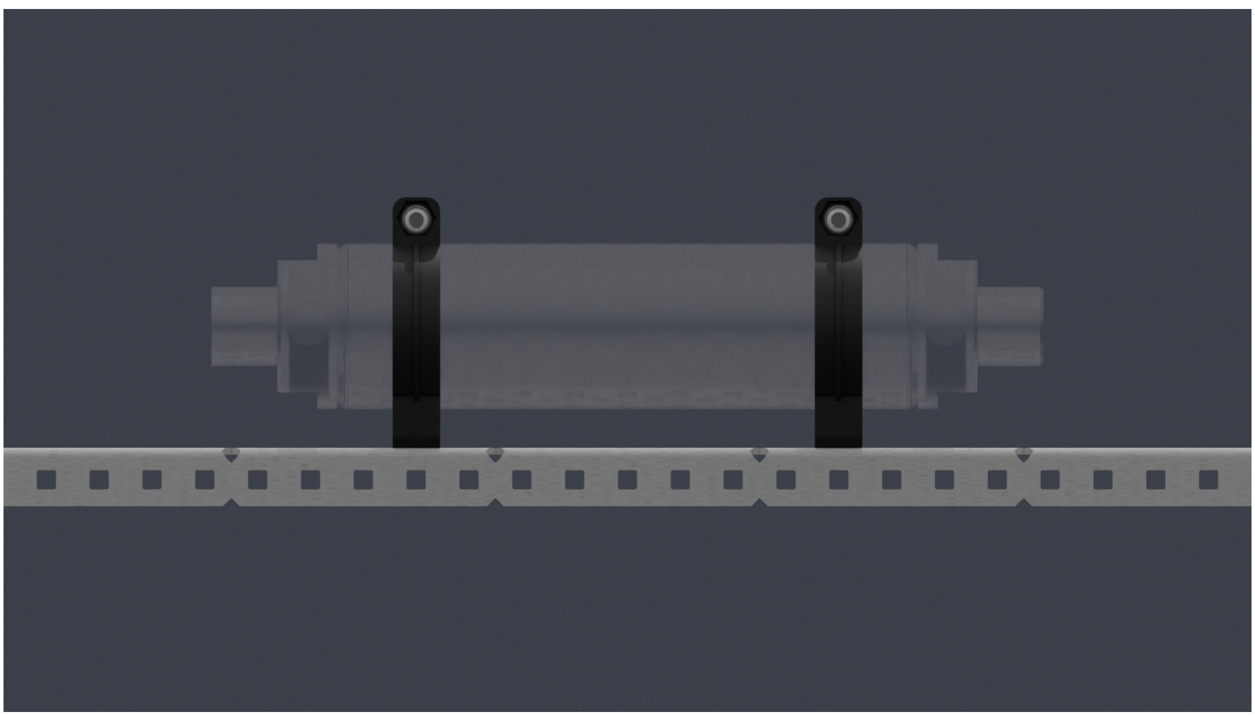

Figure 1. Air Reservoir Mount attached to a C-Channel with reservoir

Design Process:

In designing something to hold a very large object, we wanted to make the mount as simple and small as possible. There is .5 in between the holes of the C-Channels, so to avoid the piece from covering many holes, the base of the mount was extruded to .45 in, just under the .5 in space.

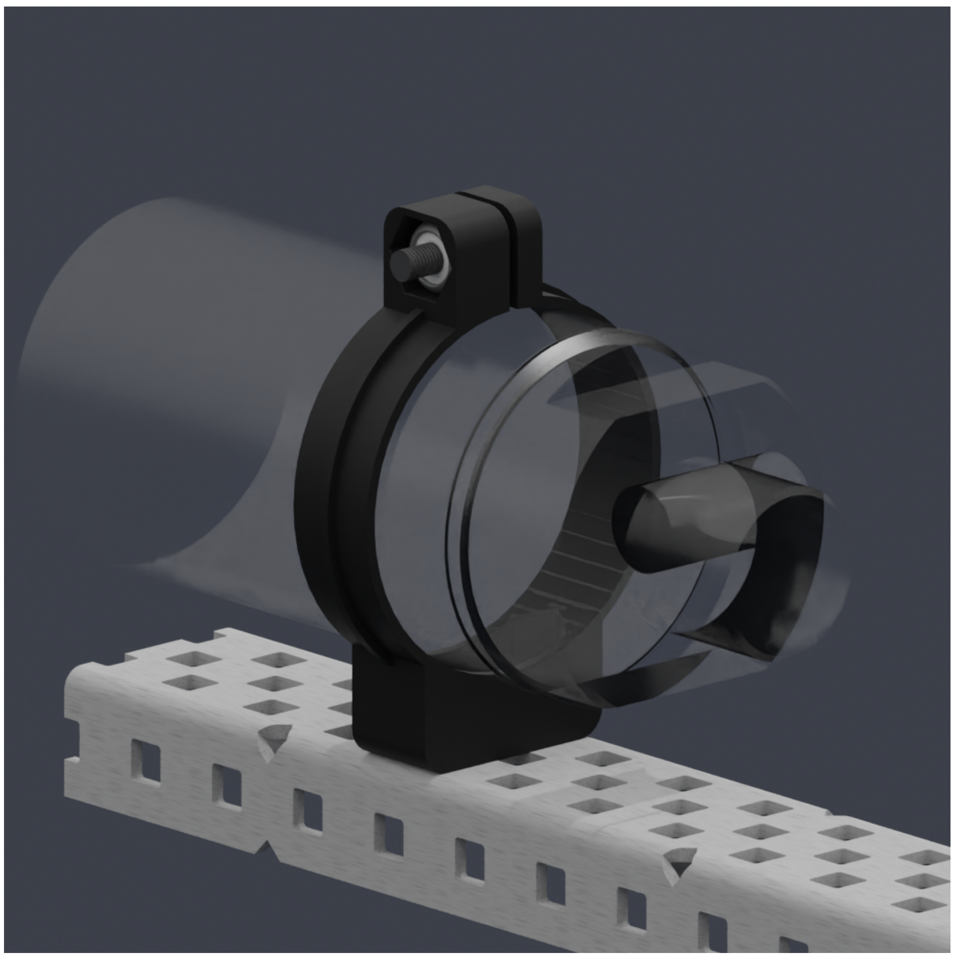

Figure 2. Air reservoir mount attached to a C-Channel

The most common solution to holding air reservoirs previously was to use zip ties, however, that method is inefficient. The material and design of zip ties allow for reservoirs to slip out. Because of this, the solution was not permanent and the zip ties had to be replaced many times during a competition. For that reason, we made the diameter of the inside surface 1.565 in. Downloading the part files of VEX parts into an assembly file in Autodesk Inventor 2022 allowed us to measure the parts with precision within 1/100 of an inch. We discovered through that method that the diameter of the reservoir is 1.565 in, and because slipping was such an issue before, we made sure to allow for little to no tolerance by making the inside diameter the same as the reservoir.

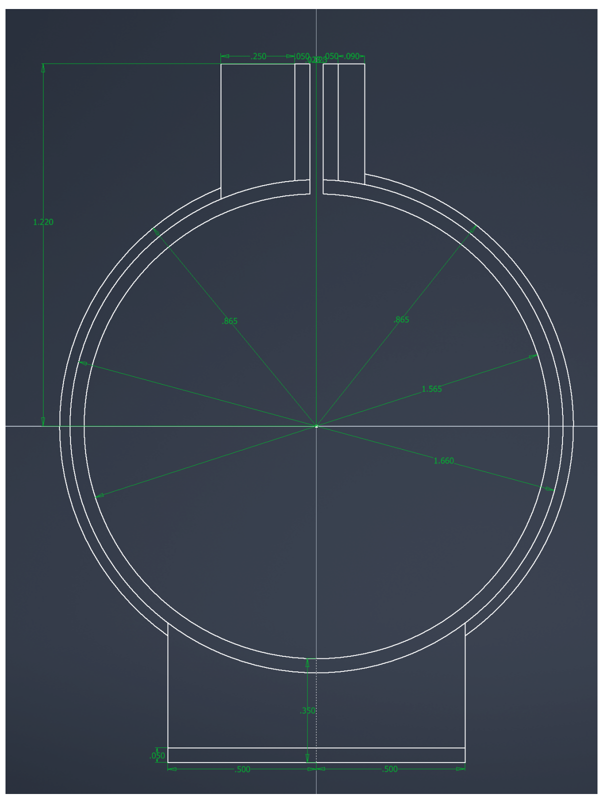

Figure 3. Inventor sketch of the diameter of the mount

The extrusion around the mount was also added to strengthen it, keeping it from flexing and breaking when printed. This lip served us well, as our first print snapped under pressure while the second version with the lip remained intact.

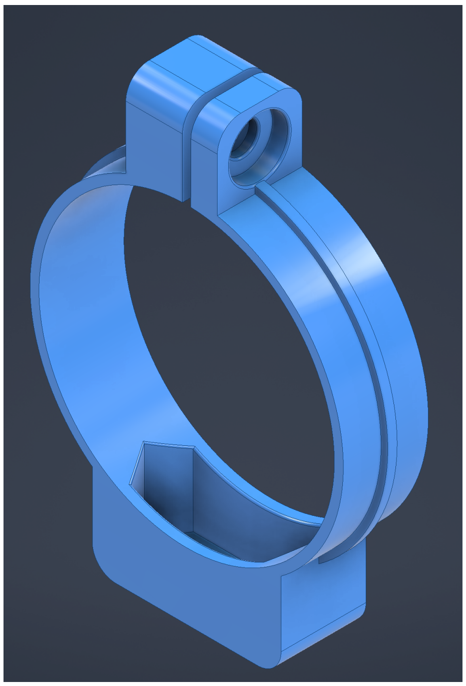
Figure 4.1. Mount with lip

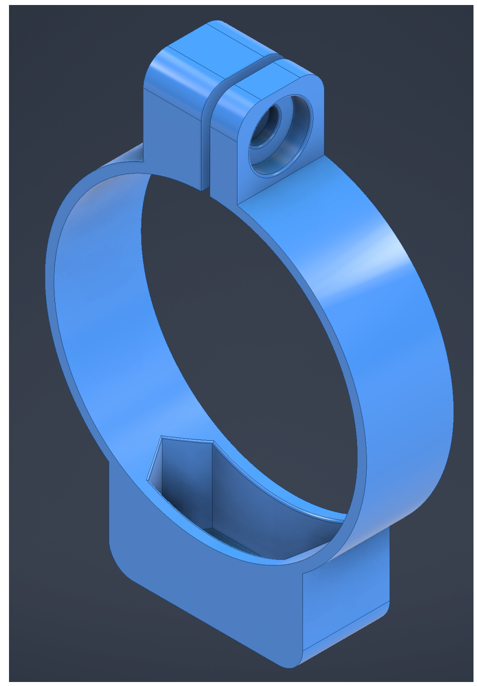
Figure 4.2. Mount without lip

For mounting the mount itself, we wanted it to be easily removable. We took inspiration from the existing battery clip parts from VEX and incorporated some of that design into the reservoir mount. The battery clip has a slot for nylon nuts to be placed into where it will stay in place while a screw is inserted into it, therefore removing the need for a wrench when removing and placing the mount. We did a similar design with the base of our air reservoir mount. There is a slot where nylon nuts can fit into for the same effect as the battery clip. The polygon tool in Inventor was used to create a precise hexagon shape that would fit the nylon nuts perfectly so they wouldn't move when screws are being inserted into it. This is easily attached to a C-Channel.

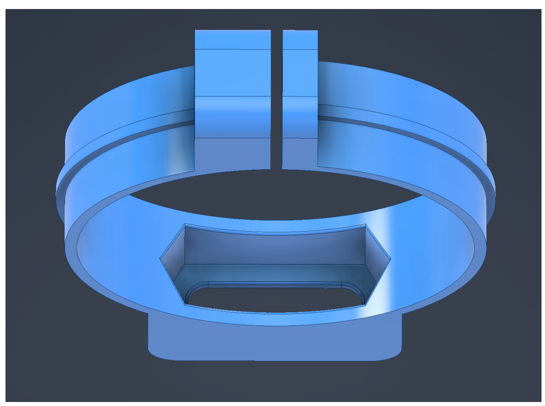

Figure 5.1. Reservoir mount with hexagonal pocket in base

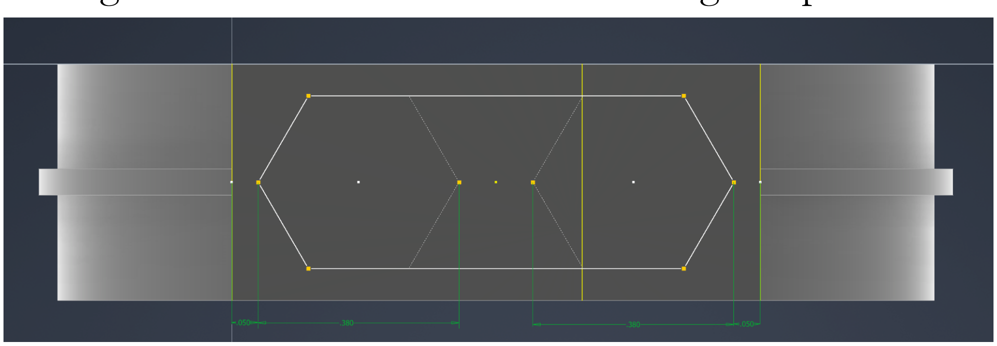

Figure 5.2. Hexagonal sketch made with polygon tool

The beautiful simplicity of this design is on full display when looking at the locking mechanism. There is no outside locking mechanism, instead, there is a built-in one at the top of the mount. There, a screw and nut hole lay, and the tighter it is screwed, the more enclosed the reservoir becomes in the mount. It acts similar to a high-strength shaft collar, where the nut and screw determine the tightness of the part. This also means the reservoir is easily removable, as it is only one screw keeping it steady.

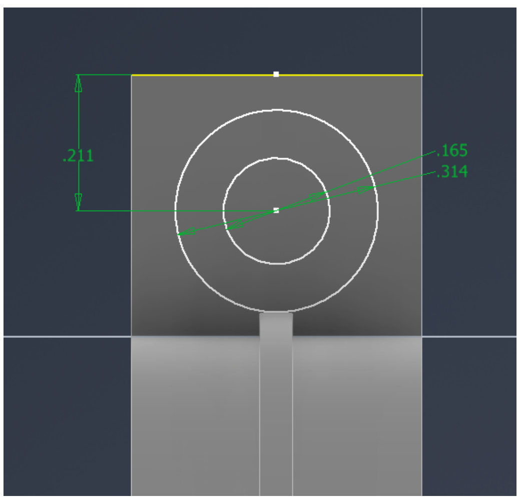

Figure 6.1. Locking mechanism screw hole sketch

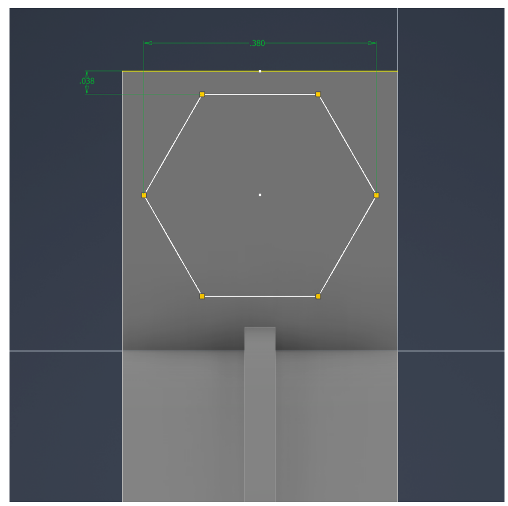

Figure 6.2. Locking mechanism nut hole sketch

Figure 6.3. Side view of locking mechanism

The holes of the mount were edited via the fillet command so that no rigid edges were on the mount. If there was, there's a chance parts or wires or tubing could catch on it, ruining the functionality of the robot. The top and bottom lips were filleted .125 in and the screw holes were filleted .01 in.

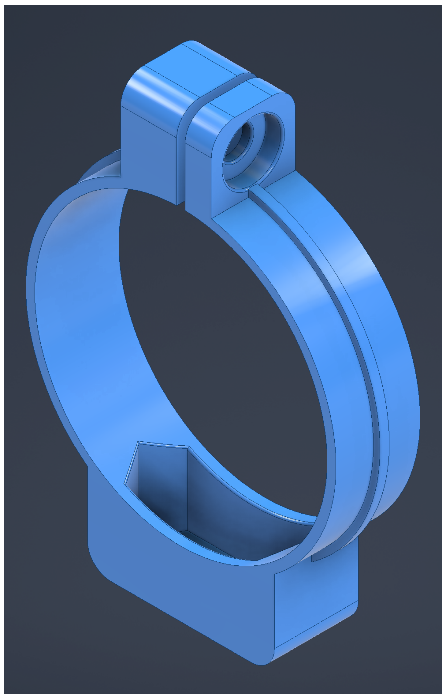

Figure 7.1. Mount with filletted edges

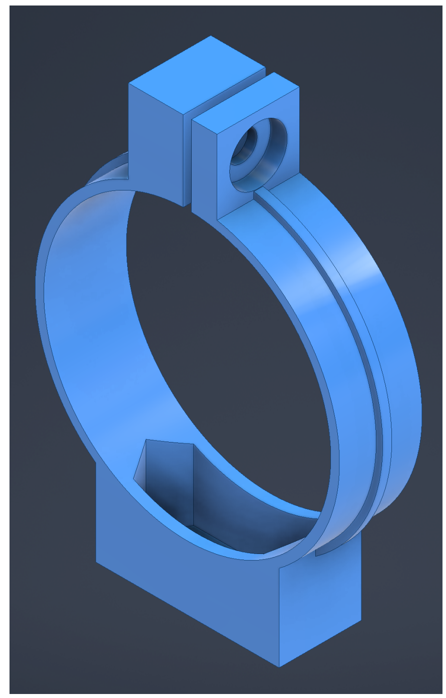

Figure 7.2. Mount without filletted edges

Once the design was finalized, it was finally time to test. We attached it to the lift of our robot for testing. The base of the mount worked perfectly, it was easy to attach and detach. The reservoir fits perfectly within the mounts. The locking mechanism was functional, and the air reservoir was successfully held.

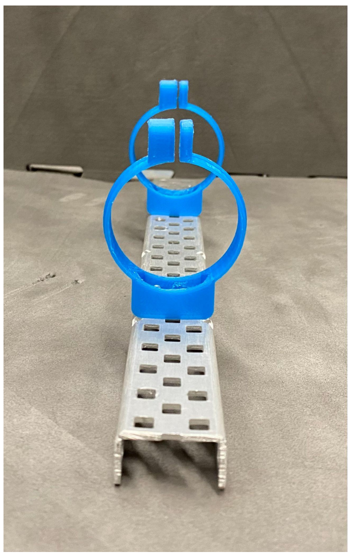

Figure 8.1. Printed mount on C-Channel

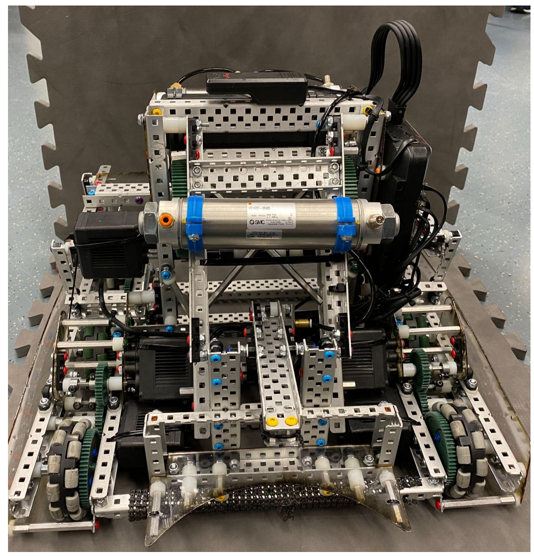

Figure 8.2. Printed mount with reservoir on robot

Figure 8.3. Printed mount with reservoir on C-Channel

Conclusion:

During the process of this challenge, our team learned many things. For one, the use of CAD for planning is unlimited. Perfect spacings and fittings could be found without ever seeing a physical part, and that process of planning is incredibly useful. However, planning with CAD is not a catch-all. While the locking mechanism did function, it was not how we expected. We made the tolerance of the hole to be quite small, and when it was printed with PLA filament on a Prusa Mk 3, the nut didn't actually fit all the way into the hole. Instead, the nut was on the outside of the hole, holding the reservoir tightly using a longer screw than what was imagined in the CAD. When working with programs such as Inventor, it is important to take the tolerances of the material you're using into consideration, and our team will take that listen and implement it in the future.

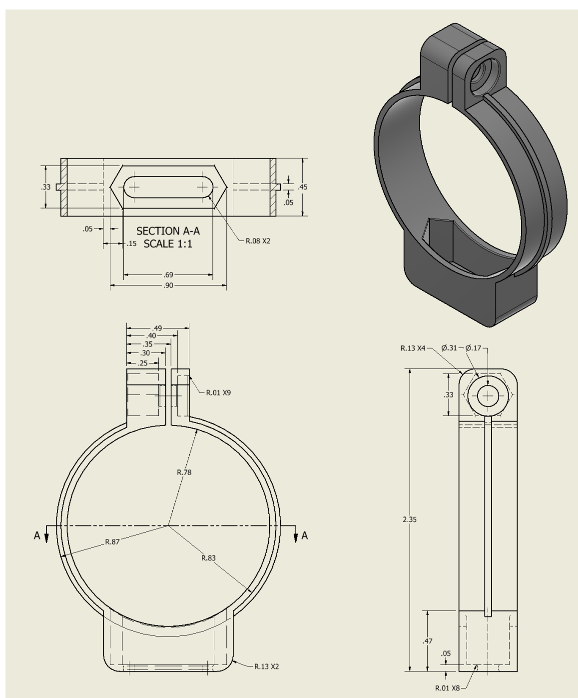

Figure 9. Drawing file of mount with orthogonal view
Link to see mount in a browser: https://autode.sk/3AadoYV