Pneumatic Tank Supports

2018 Make It Real CAD Engineering Challenge
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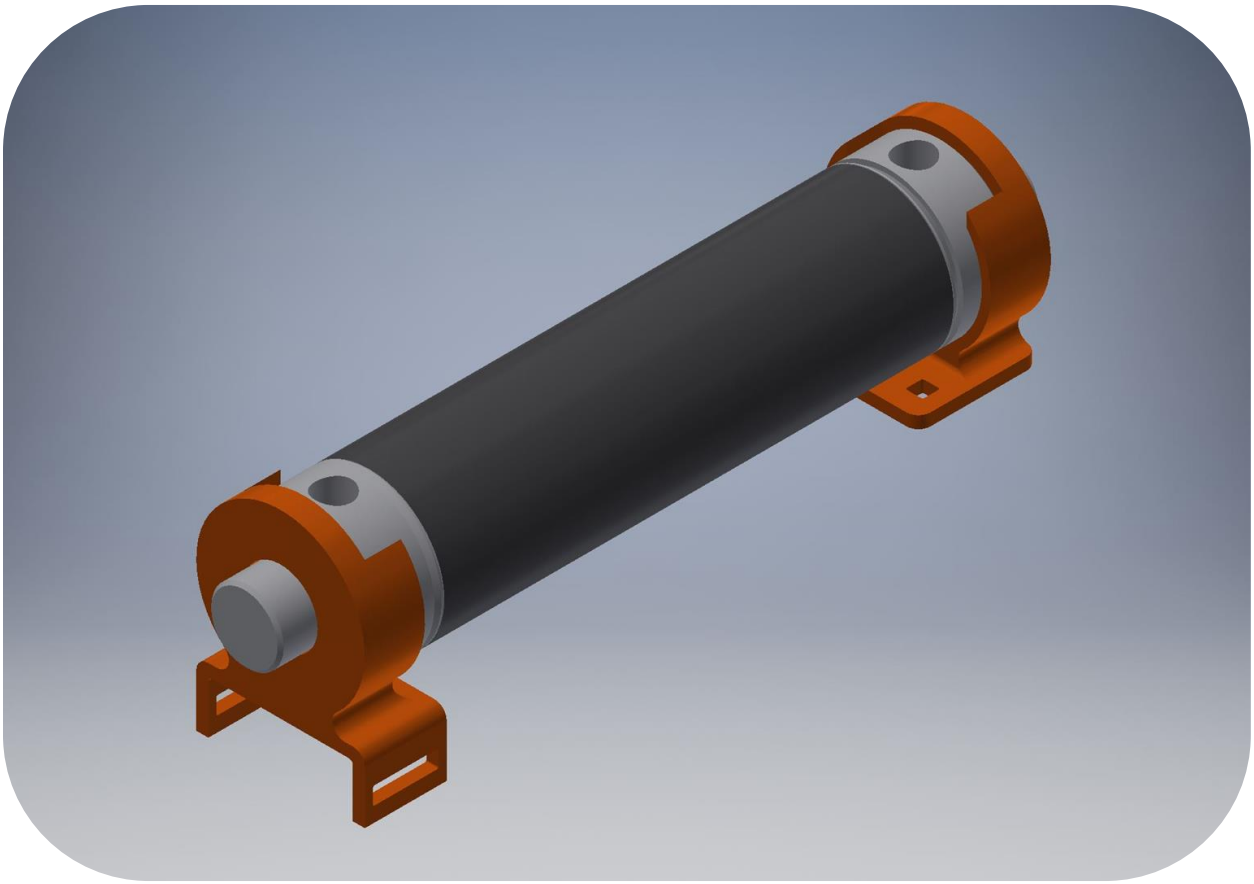

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Introduction

Actuators are a critical part of any robotic design. In the VEX Robotics kits, two types of actuators are motors and pneumatics. Motors are used in nearly every mechanism, and there are different methods and structures for effectively securing them. Pneumatic systems are just as powerful, but there are few methods for effectively securing and mounting pneumatic tanks - arguably the most important component of a pneumatic system. Common methods of securing pneumatic tanks include rubber bands, large zip ties, string, and a standoff or metal cages; the first options are prone to breaking resulting in tanks that fall off the robot while the standoff or metal cages are too bulky. To address this issue, it was decided to develop a custom part for the Make It Real CAD Engineering Challenge and integrate it into an existing robot design. As stated in the challenge description, the part should be useful, efficient, simple and elegant, and that is the premise of the Pneumatic Tank Supports.

Figure 1: *VEX Robotics Legal Pneumatic Tank*

Functionality

The Pneumatic Tank Supports are simple and easy to use. They are a slip-on design and can be mounted anywhere on the robot using screws. It is designed to fit snugly on the ends of the pneumatic reservoir, without the reservoir's hex nuts, so that there is no linear or rotational movement. Preventing the reservoir from moving linearly makes sure that the weight distribution of the robot remains as consistent as possible thereby maintaining the desired center of gravity. Additionally, pumping up the tank is easier because it cannot rotate.

These supports fit into the complete robot design because it effectively utilizes space that would otherwise be unused and it makes securing the pneumatic tank efficient. For example, support towers for a variety of lifts (four-bar, reverse-four bar, etc.) utilize the upper portion of the support structure (typically C-Channels), and the lower portion remains unused. The Pneumatic Tank Supports can be mounted in the empty space, thus utilizing it. In terms of securing, using these supports reduces the number of tools needed in the tool box. A wire cutter is needed to remove excess length of a zip tie and is also needed when removing it. By utilizing this support, the same tools used to assemble the robot can also be used to attach the Pneumatic Tank Supports.

Figure 2: *Pneumatic Tank Support (Assembly File)*

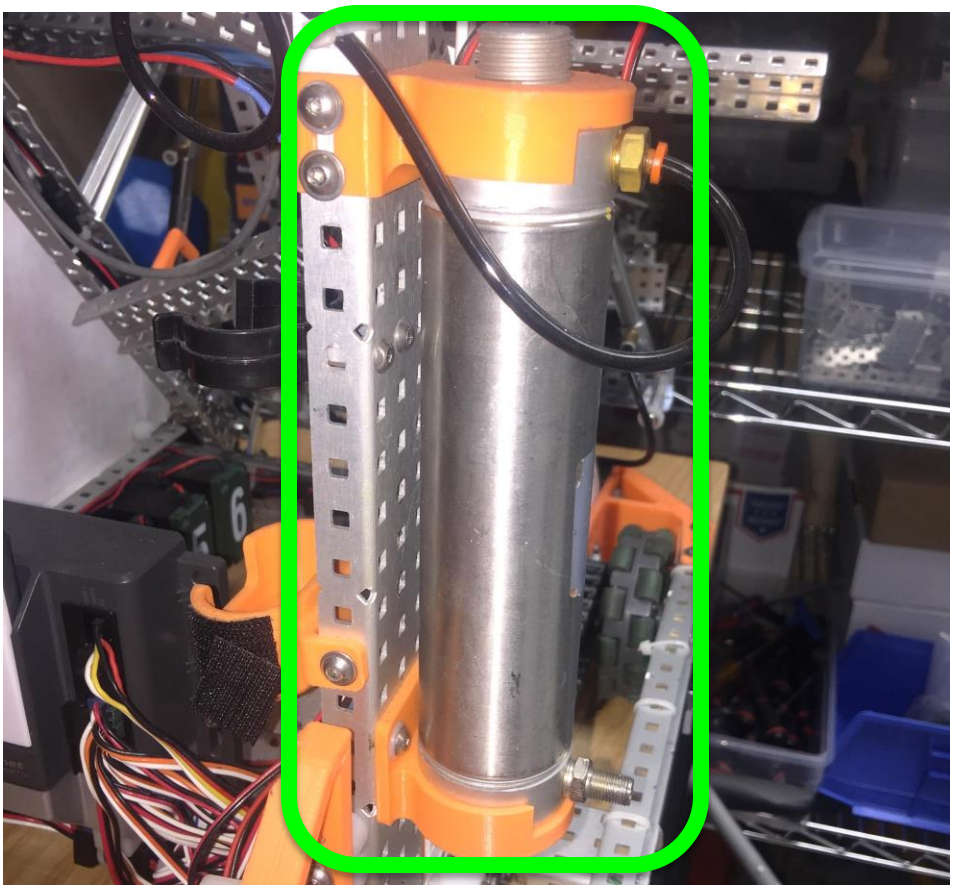


Figure 3: *Pneumatic Tank Support (Real Life)*

Design Process

The best way to design the Pneumatic Tank holder was via 3D design software with the goal of 3D printing. Our design is used in conjunction with VEX parts, so it can be used for any design that needs Pneumatic Tanks. Our design could even a VEX Robotics manufactured part because of the simple, easy-to-use design and because it is strong and lightweight.

To design these supports, the engineering design process was utilized. After building our robot, we noticed the zipties secure the Pneumatic Tank were not conducive to a well-functioning robot. To solve this problem, we needed to design a custom piece. The following details design approach and the steps taken in order to create the Tank Holder supports in Inventor:

1. Based on real-life utilization of Pneumatic Tanks, we compared how the Pneumatic Tanks fit when secured 5-hole and 3-hole C-Channels; the 3-hole C-Channels were used on the since it sat nicely inside. We determined the custom pieces are equivalent to width of a 3-hole C-Channel.
2. Designing using Autodesk Inventor 2016 Professional (Student Version):
    a. The Design Process (discoveries regarding the Pneumatic Tank Support)
        i. Needs to have more structural support and stability
        ii. Needs to have clearance from wheels and gears
        iii. Pieces must have the ability to hold the tanks securely and support the weight of the tank
        iv. Various ideas were visualized graphically before the final selection
    b. The Engineering Process
        i. Measured space equivalent which is 3 hole; this reference was used as the main dimension
        ii. Pneumatic Tank Support assembly file was modified to ensure it fit nice and snug
        iii. Two Inventor file parts were created for the pneumatic tank: one for the top and one for the bottom
        iv. Measurements, in inches, were taken for the distance between the mounting holes, and distances for the bottom support
        v. Using a series of 2D Sketches made completely from geometric shapes, the outline of the part was created
        vi. Extrusions, 3D representations of the 2D Sketches, were used with slight alterations
        vii. Filets were used to improve the integrity of the part by rounding out the edges

viii. 3D Parts were then added to the assembly file to ensure the correct measurements as well as to assess future potential modifications

3. The Manufacturing and Distribution Process
    a. Upon completion, part files were converted to STL files
    b. STL Files were imported into software and sliced for 3D printers
    c. Files were printed and used for supporting pneumatic tanks

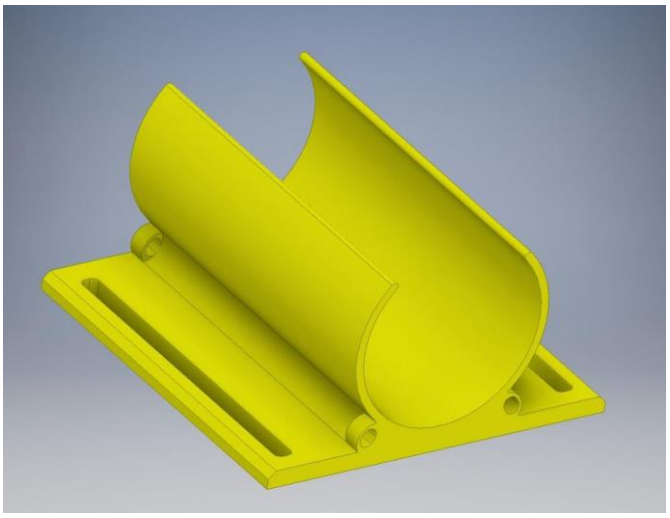
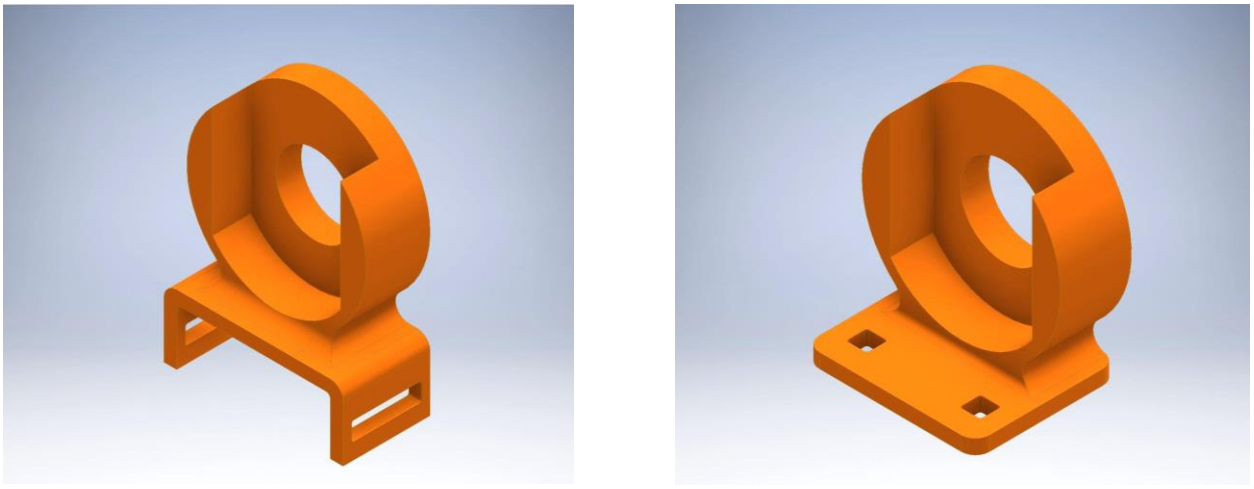


Figure 4: *Pneumatic Tank Support (First Design)*



(A) **(B)**

Figure 5: *Pneumatic Tank Support (A - Top Part File, B - Bottom Part File)*

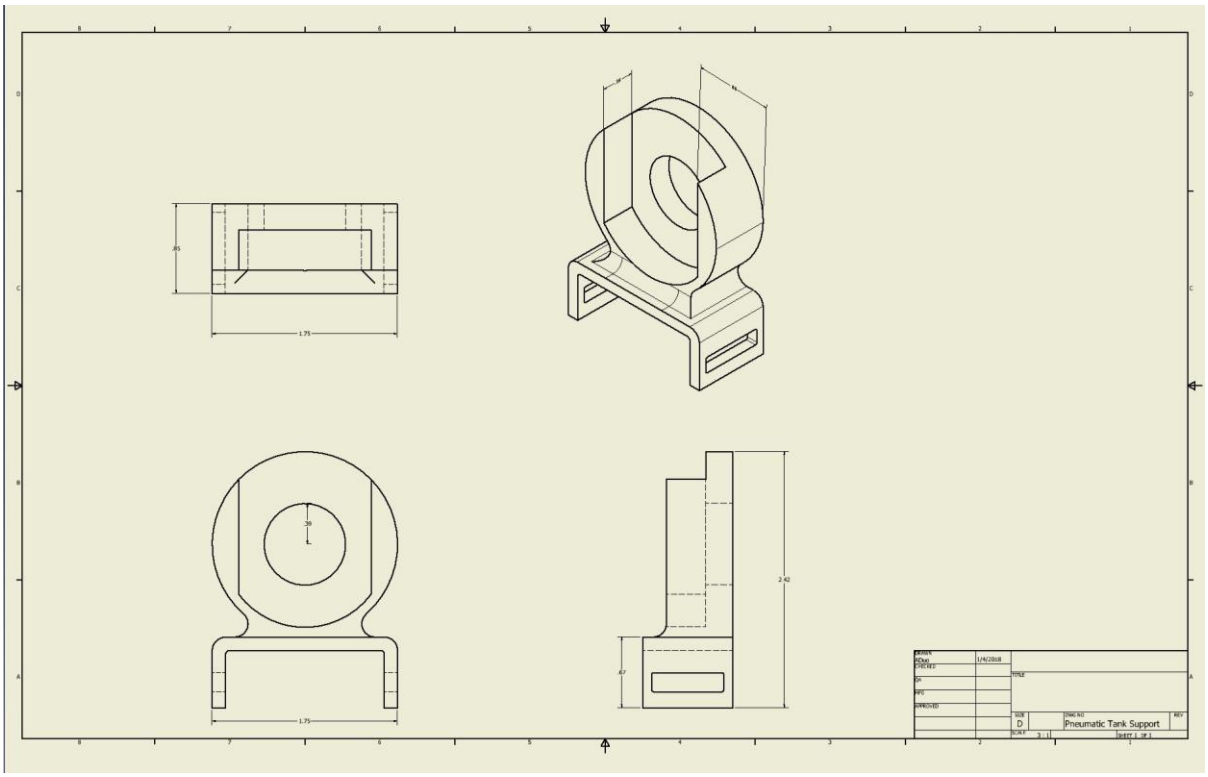


Figure 6: *Pneumatic Tank Support Top (Mechanical Drawing)*

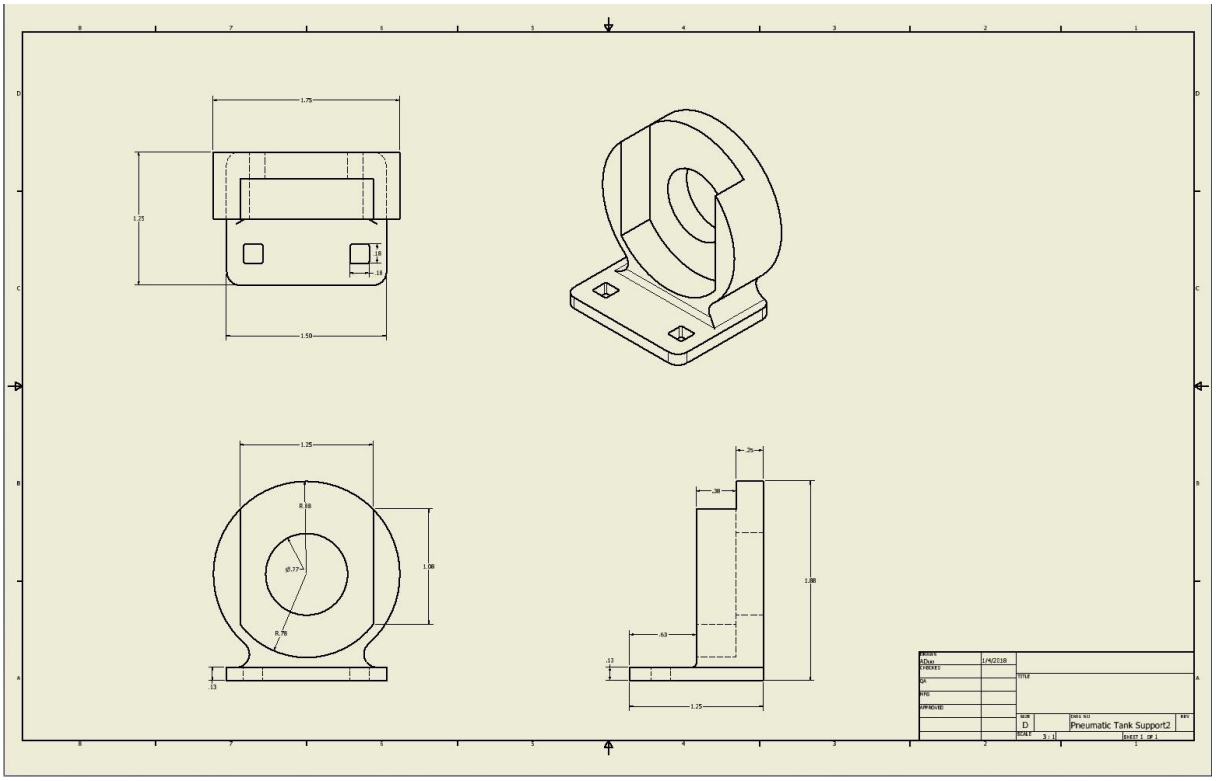


Figure 7: *Pneumatic Tank Support Bottom (Mechanical Drawing)*

Conclusion

While working on the Pneumatic Tank supports, from the initial ziptie method to the 3D parts, we learned that even something as simple as connecting two pieces of metal together involves the engineering process. 3D design software such as Autodesk Inventor opens up a world of possibilities for structural designs and is especially useful for members of a competitive robotics team because the ability to incorporation of 3D parts nurtures functional creativity and imagination. We will continue to use Inventor not only for robotics competitions, but also for our individual and group design projects that we work on during the academic year and at home. As our team is composed of mainly electrical and mechanical engineers, it is necessary for us to understand how to use CAD software for schematics and 3D design software for prototyping. Having a working knowledge of both strengthen our skillset and make us more well-rounded engineers.

About Team NYIT

NYIT has been competing in the VEX U college division since 2010. Each year we learn more and are able to grow more as a team, with our accomplishments being largely aided by advancements in technology. Amongst these major developments include improvements in computer-aided design technologies. Using CAD software, particularly Autodesk Inventor has been a critical part of our growth and our team has designed many parts for our VEX competitions. NYIT's career being a part of VEX has been a great experience for all of our students, our school, and our community.