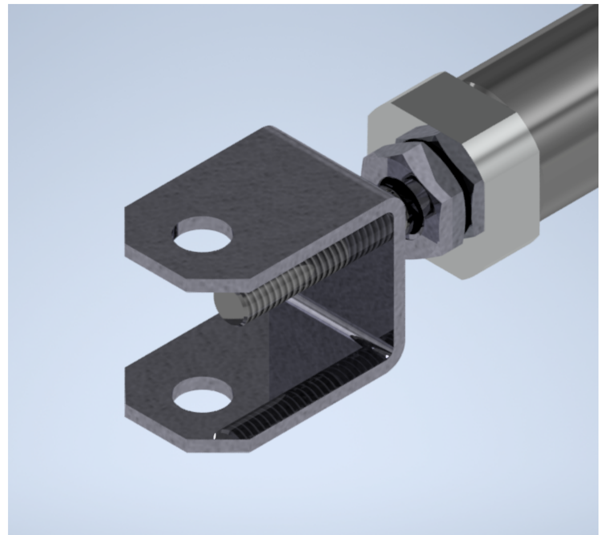
Pneumatic Piston Attachment Slide

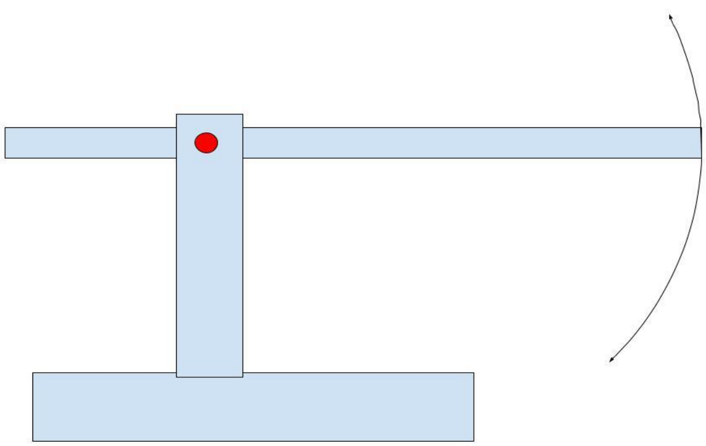
Team 39k from Bloomfield Hill, Michigan

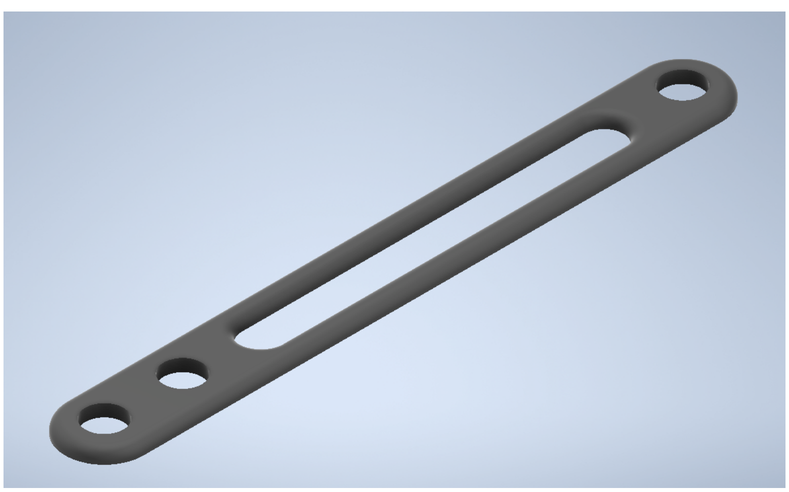
The Challenge:

This year's rule changes provided a unique incentive for teams to use pneumatic components in their designs; the removal of the motor penalty means that using pneumatic components is "free" power for subsystems.

However, the vex-approved pneumatic components are unique in the fact that unlike all other vex electronic parts, they are industry standard and not designed to fit within the vex architecture. The primary issue is the attachment point on the piston: its awkward shape and hole size means that it can't easily attach to the standard VRC approved parts. However, the second issue concerns the longevity of pneumatic systems: as teams build subsystems around pneumatic pistons, they try to accomplish nonlinear movement, or movement on a slight angle, with the pneumatic pistons. This can cause a decrease in the actual mechanical advantage (AMA), but more importantly can cause wear on the piston, causing leaks and shortening the lifespan of a very expensive part.





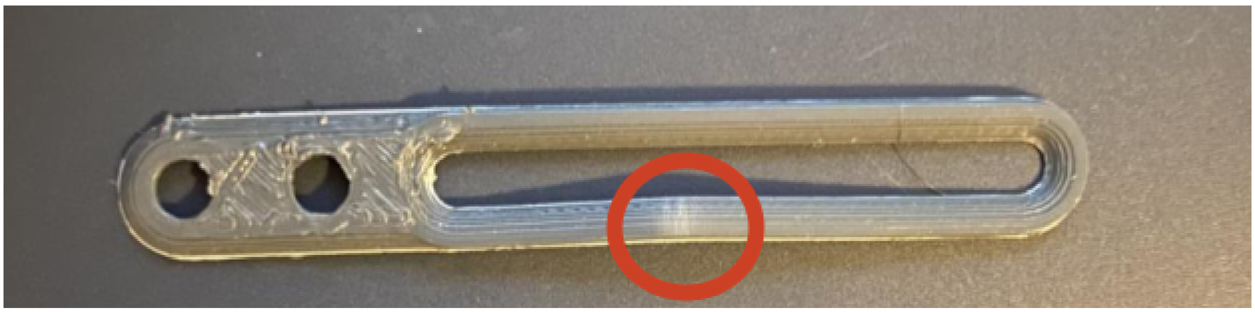


Our Solution:

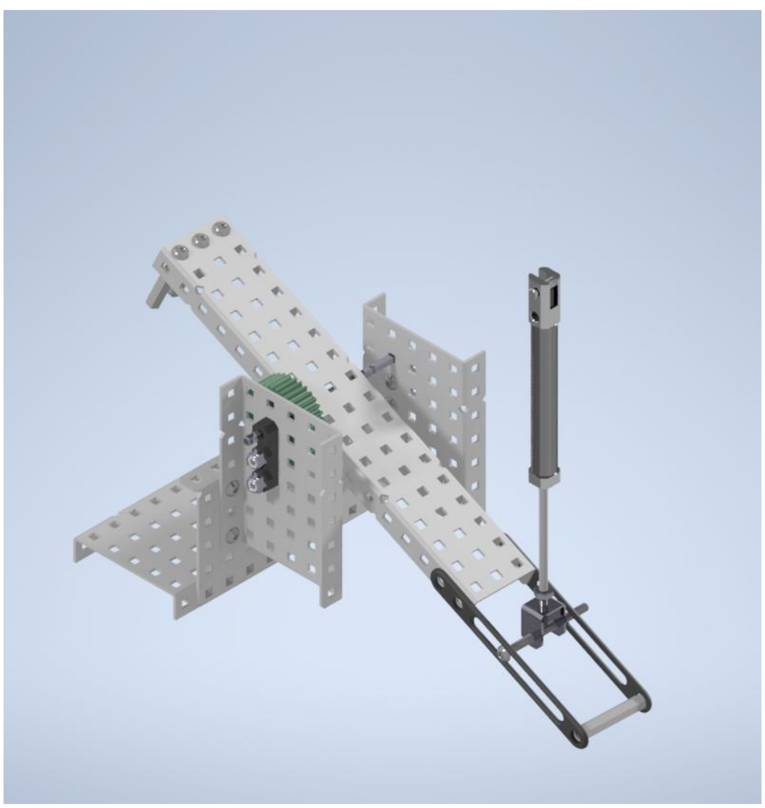
For us, the outline of the project was clear: we need a part that can both adapt the awkward angle of the piston to a VRC legal C-Channel while allowing for a range of horizontal motion. The solution was a slide with 3 holes: 2 for mounting to a C-Channel, and one to brace the two sides with a standoff between.

Inventor and the Design Process:

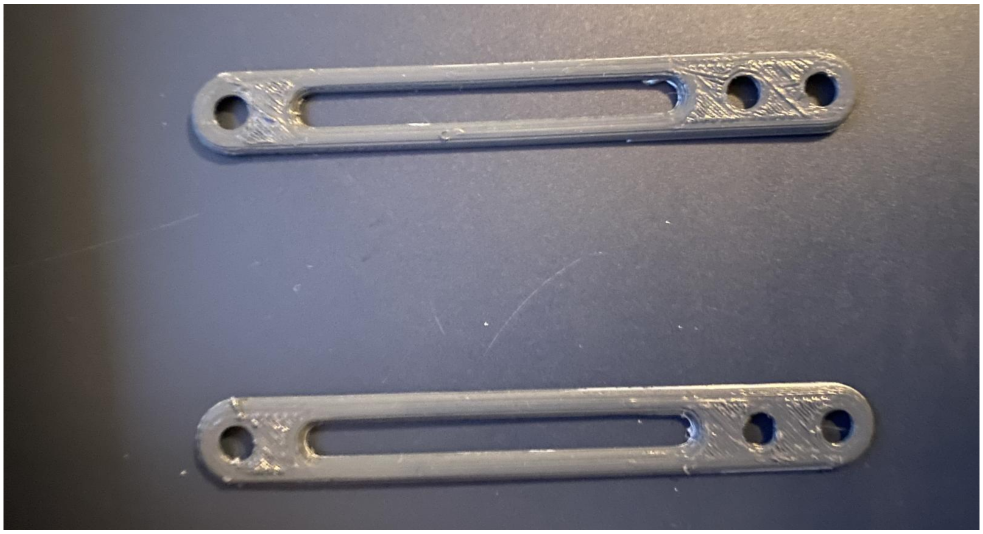
To design this part, we utilized Autodesk Inventor Professional 2021. We started off with a simple rectangle with a hole cut in the middle and then added curving to the inner cut in order to better fit the diameter of the screw, which would be used for the slide itself. VRC metal has holes .5 inches apart, so we added the 2 holes on the edge so it could mount anywhere on a VRC legal robot. Finally, we extruded the part 2mm. We based this off Inventor's material and stress testing functions, setting the material of the part to the same as VEX produced bearings. At this point, we felt like we had gone far enough in the design process without testing, so we 3d printed our first iteration. It worked well, but had a small flaw in bending under load, as seen here:



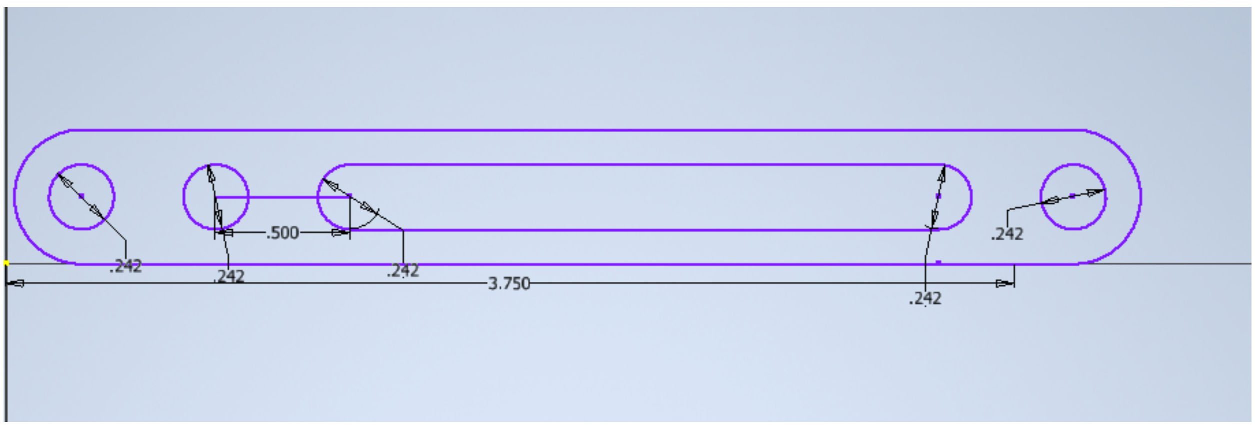
It was clear the design needed extra support, and since our design relies on having 2 sides to slide, we added another hole to brace the two sides with a standoff. Because this was our final iteration, we also used the Fillet tool to round edges but left a flat bottom, which would allow for a reduction in friction and manufacturing material while maintaining all functionality.



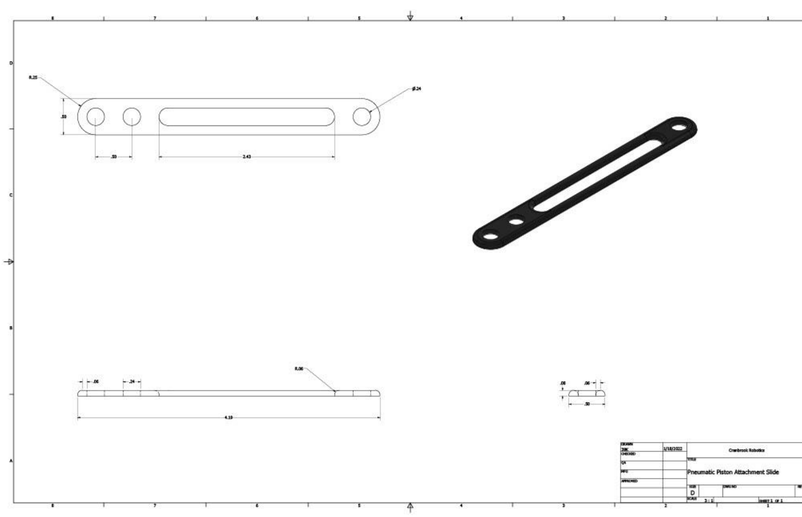
A sample use case of the part, including standoff for bracing and pneumatic piston



The Final Iteration 3D Printed



Our Final Sketch



Isometric Drawing and Dimensions, Available in Downloads

Final Thoughts:

Over the course of making this project, we learned how to better maximize the potential of Autodesk Inventor, including using the fillet, stress test, and material features. We also learned how to better present our designs with annotated drawings and used ray tracing renders for a clean final presentation. In the future, we will be using Inventor as a crucial step in the design process of all of our robot's subsystems. The software helps us ensure all the subsystems work with each other and stays within all of the constraints that VEX sets out. Adding CAD as a step in our design process will save us time in the lab, as we will essentially have a blueprint to build from. It also saves resources because it allows us to catch mistakes earlier on before we physically build the robot. Learning to use this software now will help me later in my career as I want to go into engineering, and software such as Autodesk Inventor is used in those fields often as a platform for design and idea-sharing.