



VRC High School - “Make It Real” CAD Engineering
Online Challenge Sponsored by Autodesk

Vex Pneumatic Bracket Add-on Kit

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What Problems That Our Design Overcome





Aimed at the new Tipping Point game, our team applies pneumatics alongside the V5 motor system. A common issue that our team encountered during our building processes was the brackets for the pneumatic pistons. In particular, the two small m3 nuts on either side of the bracket are hard to screw on (Shown in Picture-1) and would always fall off. This is because the bracket blocks the wrench from turning (Shown in Picture-2) when fastening the nut and the small spaces make it hard to screw by hand. Furthermore, having nuts on both sides is inconvenient (Shown in Picture-1), holding the first nut to prevent it from moving when screwing the second. It's even more difficult when the piston is already mounted to the robot. Additionally, certain applications require lengths shorter than the maximum extended distance of the piston. Traditionally, various spacers are added into the extending rod of the piston (Shown in Picture-3), causing the inconvenience that different size of spacers might not create the appropriate length needed. Thus, the current piston is more prone to loosening after usage as there is no fixed supports on either side of the bracket. The small size of the nuts only adds little stability to the bracket. Overall, these inadequacies of the current vex pneumatics kits required our team to check and fix our brackets frequently.

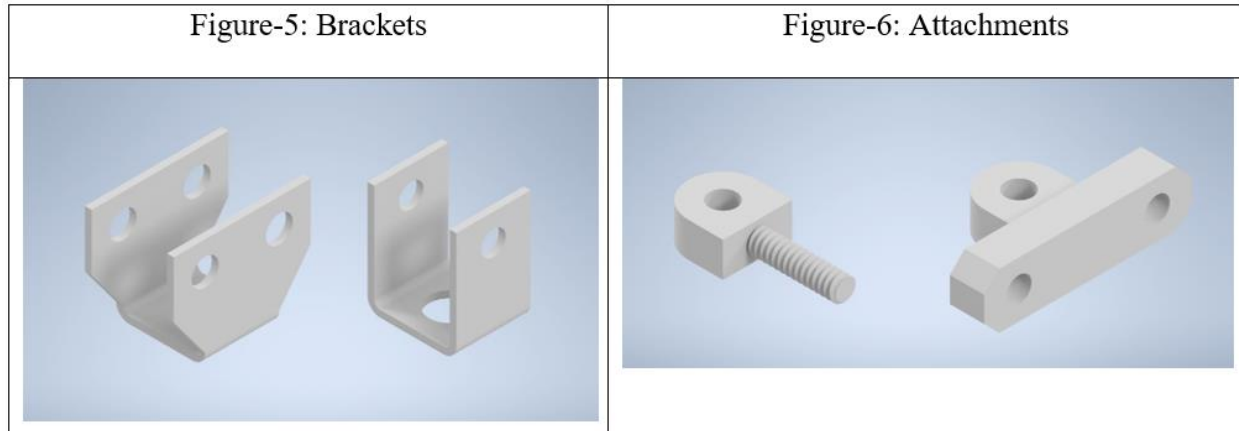
Aiming to find improvements for the aforementioned issues, our team decided to design a new *Vex Pneumatic Bracket Add-on Kit* to solve these issues, obtaining more effectiveness and more functionalities.

Picture-1: the small nut is hard to hold on the place and easy to fall off	Picture-2: the normal wrench doesn't fit inside the bracket from turning the screw, pliers are hard to use here	Picture-3: the normal size of spacers can't create the appropriate extension distance
		

What Is Included in Our Pneumatic Bracket Add-on Kit & Its Function

The Pneumatic Bracket Add-on Kit can be fitted on any robot using a single or double acting Vex pneumatic piston. The purpose of the Pneumatic Bracket Add-on Kit is to allow for easier change and better stability of brackets. The Pneumatic Bracket Add-on Kit consists of 2 sizes of *special screw* (Figure-1), *nuts* (Figure-2), 3 sizes of *stoppers* (Figure-3), 2 sizes of *extenders* (Figure-4), 2 *new brackets* (Figure-5) that are made to fit the special screw and 2 different *attachments* for brackets (Figure 6). The *special screws* have a threaded hole on the bottom and are threaded on the outside as well. The *nuts* are made to fit the outer layer of the screw and are for clamping the bracket in place. *Stoppers* are used to reduce the piston's range of motion by preventing the piston from retracting fully. The *extender* can be used to extend the length of the piston for further reach. We have two different types of *brackets*: one hole, and two holes. The one hole bracket is the same as the vex bracket and allows for pivoting while the two hole bracket is able to secure parts in place. The *bracket attachments* are useful to make connecting the bracket to other parts of the robot easier.

Figure-1: Special Screw	Figure-2: Nuts	Figure-3: Stoppers	Figure-4: Extenders
			



How To Assemble The Pneumatic Bracket Add-On Kit

The Pneumatic Bracket Add-on Kit is easier to assemble compared to the current Vex pneumatic brackets since most of our new parts can be assembled onto the *special screw* before attaching it onto the piston. The *special screw* itself can also be screwed onto the piston with a standard Vex hex screwdriver. In addition, this design is more sturdy and less likely to loosen as the *bracket* is tightly secured against the *special screw*.

Implementing the Pneumatic Bracket Add-on Kit onto the pneumatic pistons is easy.

Step-1: To attach the *bracket*, first slide it onto the *special screw* and then clamp it with the *mounting nut* in any orientation.

Step-2: *Extenders* can be screwed on the piston rod.

Step-3: *Stoppers* can be installed on double acting pistons and are screwed on the base of the piston.

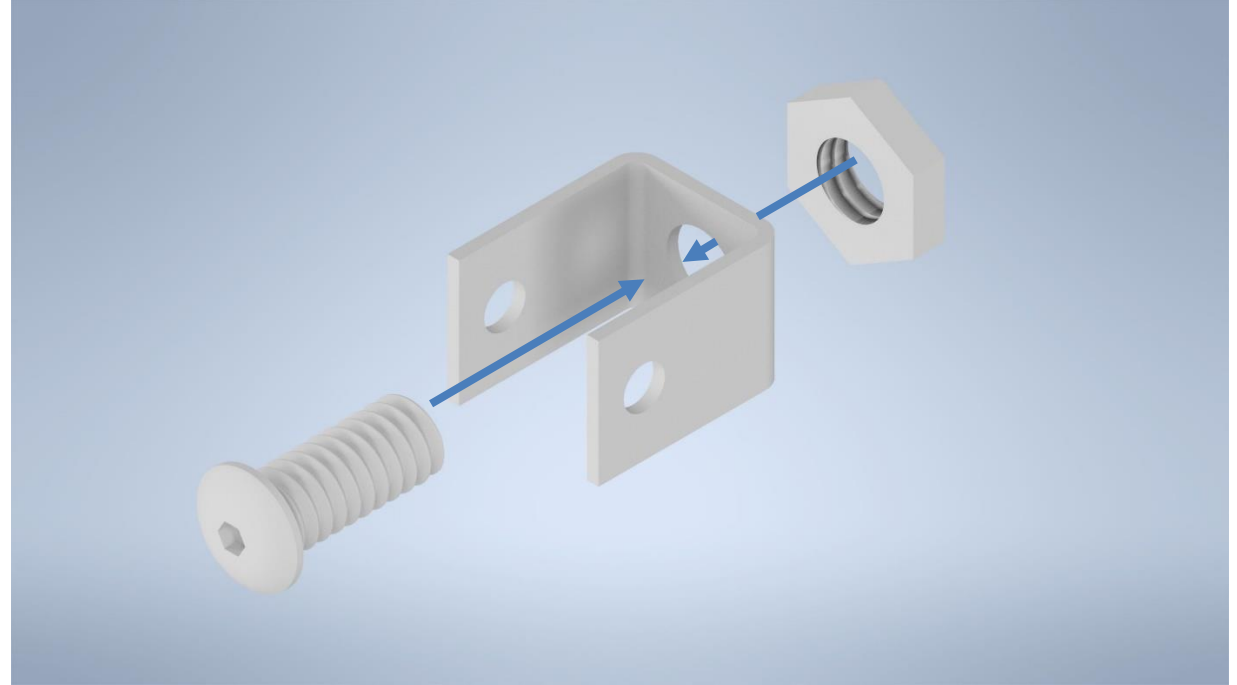
Step-4: After assembling the desired parts the *special screw* made from the Step-1 is then screwed onto the piston.

Step-5: Finally, screw on the *special screw* which holds the parts onto the *extender* or piston rod. *Attachments* for the bracket can be put on with regular Vex screws and locking nuts or with axles.

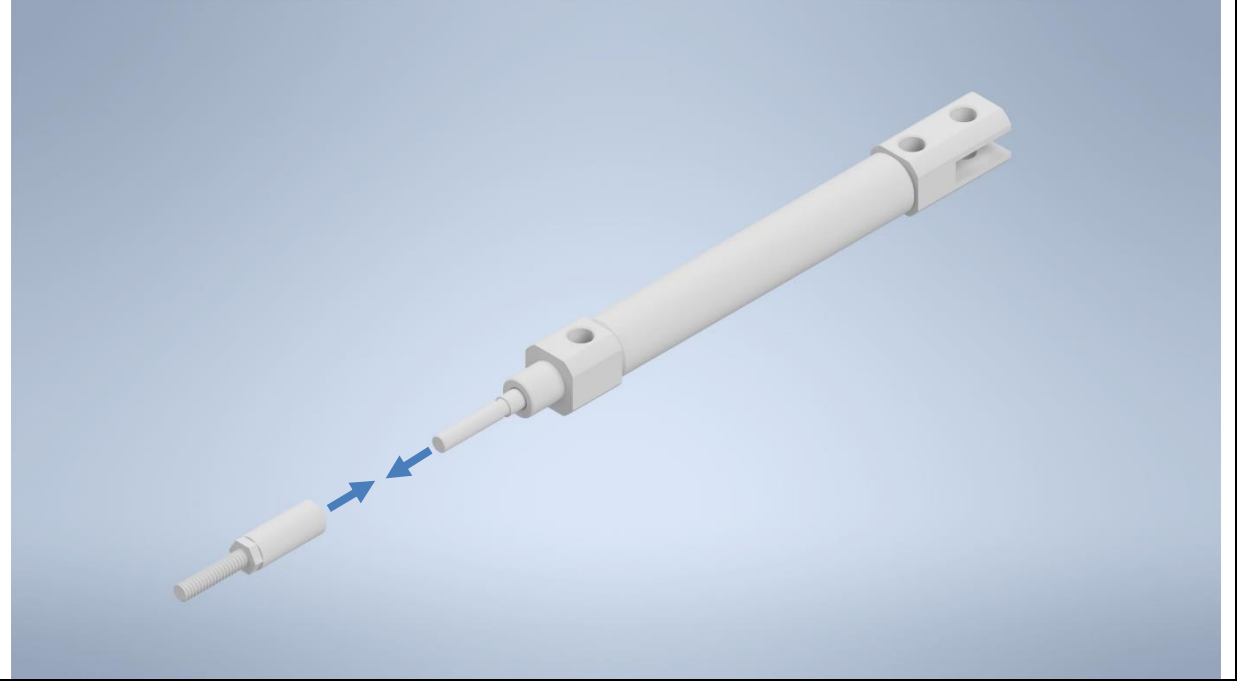
Step-6: That is how the final result looks like.

General Assembly Steps:

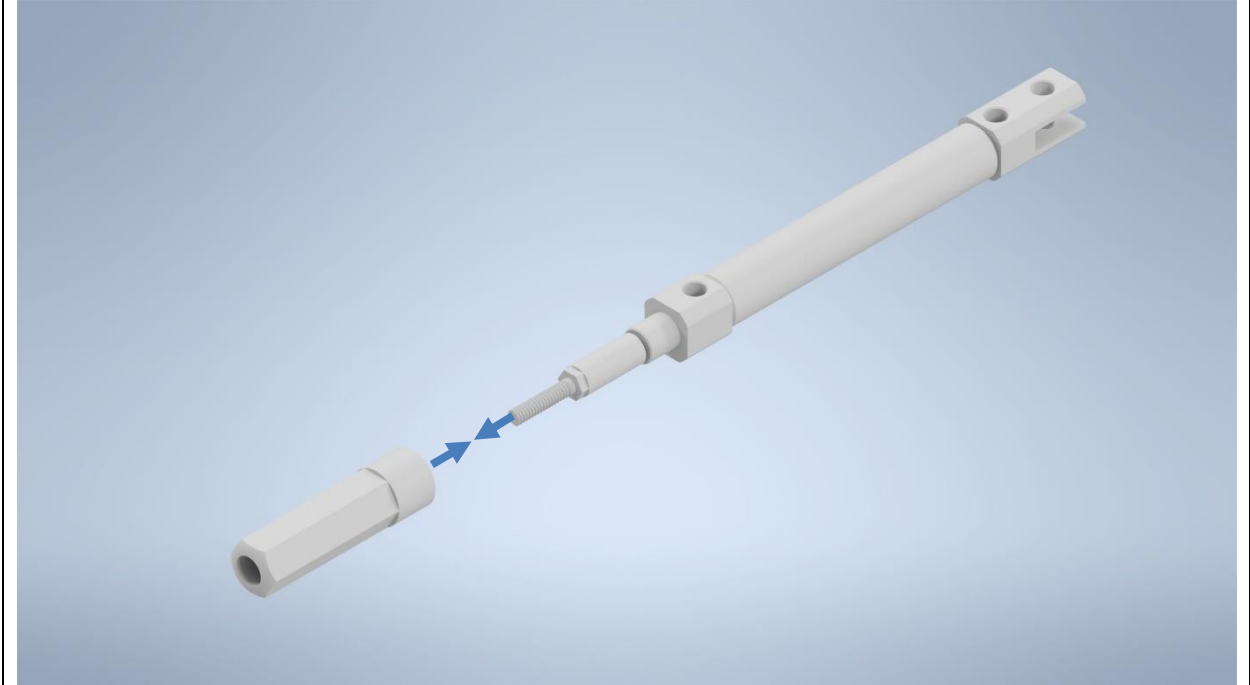
Step-1: Slide the bracket with the special screw and nut



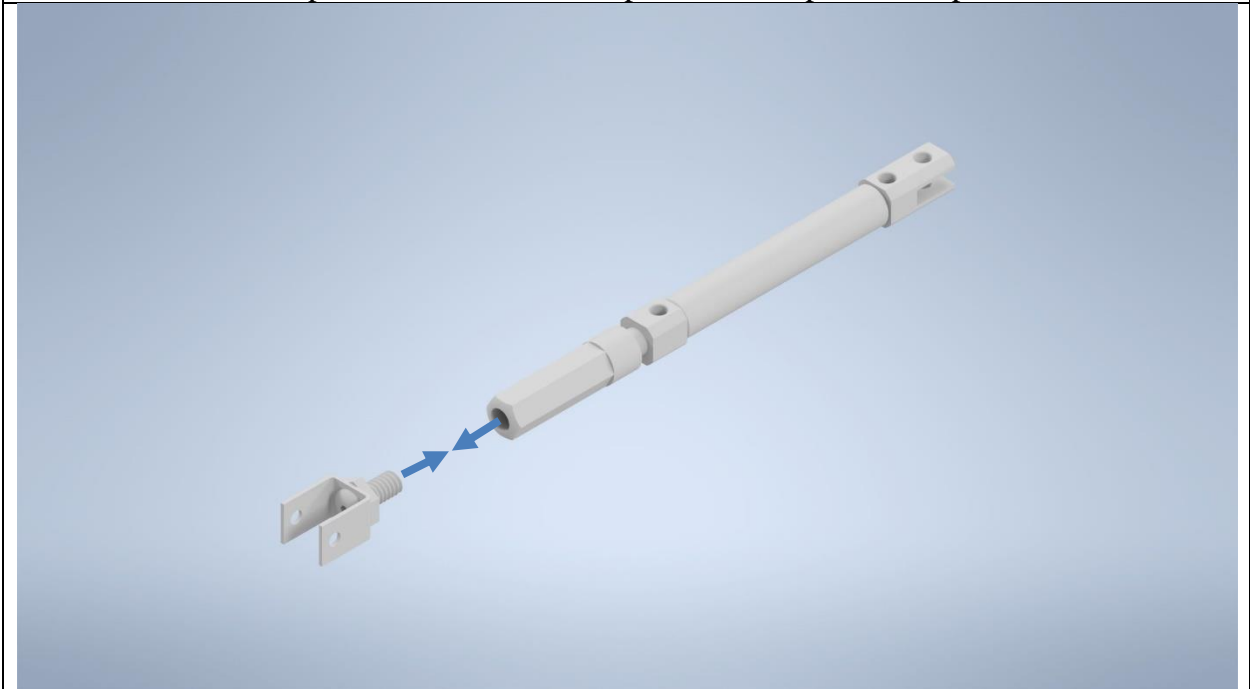
Step-2: Extender is screwed onto the piston rod



Step-3: Stoppers are screwed onto the base of the piston



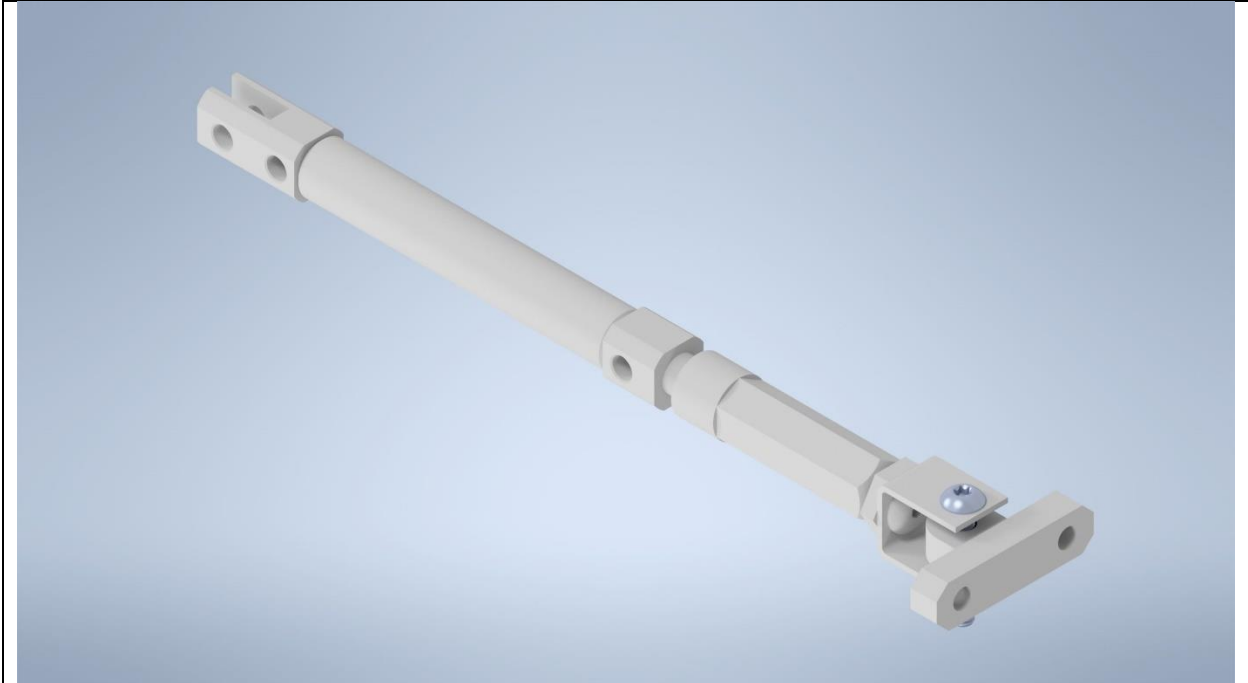
Step-4: Combination of the parts from Step-1 and Step3



Step-5: Special screw and attachments are mounted together with Vex normal screw



Step-6: Final outcome



The Advantage of Autodesk Inventor

To model our parts, we used Autodesk Inventor. The body of the parts were mostly created using sketches on a 2D surface then extruding them. The extrude feature was extremely convenient and helped save a lot of time as the majority of the parts had a cylindrical shape. Furthermore, for any rounded area such as the top of the screw and the bottom of the stopper, they were created using the revolve feature to revolve a 2D sketch 360 degrees. Lastly, we used the thread tool to create the appearance of threads on the parts. Autodesk inventor also allows for easy creation of assemblies to create mockups between our custom add on kit and the existing pneumatic pistons. Using the insert constrain allowed for easy placement of parts, while using the joint feature allowed us to replicate the model to reality as much as possible.

What We Have Learnt

This project taught us about the basics of modeling a unique part as well as various features in Autodesk Inventor to help us do so. It encouraged us to reflect on the source of our problems and come up with a creative yet simple solution to resolve it. The design philosophy around our add on kit revolves around simplicity, making it easy to manufacture and use while allowing teams greater functionality and control of their pneumatic systems. We've learnt to incorporate this design language into not only our CAD, but into our robot and code as well.