The Pneumatic Locknut

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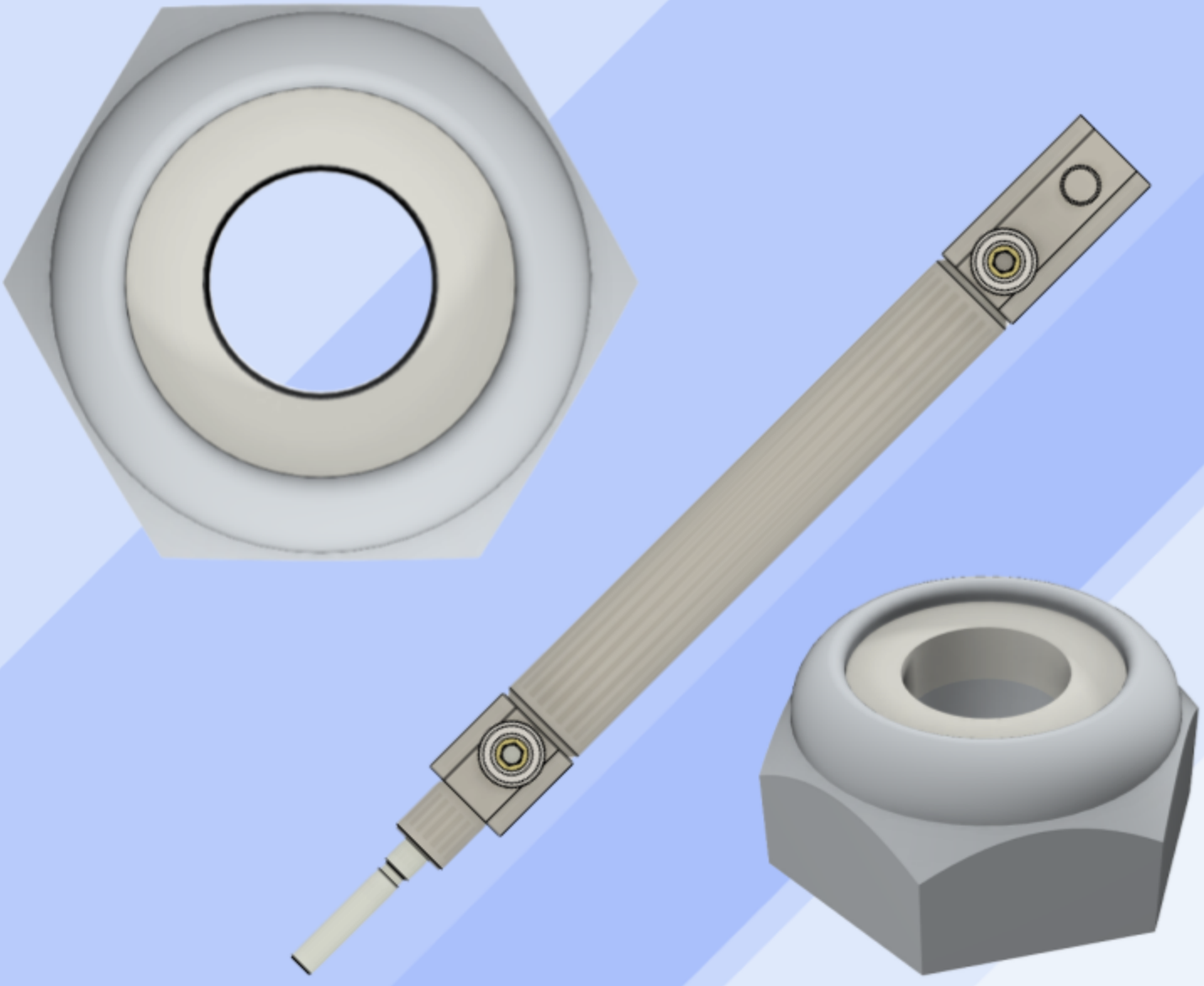
Make it Real Challenge | Team 393A | Tustin, CA



Introduction-

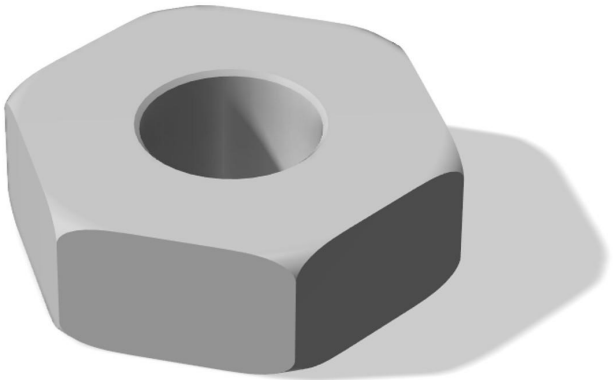


Fig. 1: A Regular Pneumatic Nut produced by SMC

Pneumatics provides a competitive advantage for VRC teams. Since teams are allowed to use pneumatics and eight motors these past few years, teams have been using pneumatics to power different subsystems while still maintaining eight motors to play around with. This allows for more overall power in a robot's subsystems, as more motors can be placed in more important subsystems. Most teams have used pneumatics for claws, power-sharing mechanisms, and recently mechanisms to expand their robot.

However, pneumatics in VEX has one glaring issue: the nuts that retain their attachments. These nuts are the only thing keeping a team's mechanism connected to the piston. These nuts come off easily and far too frequently. This is due to the lack of a locking mechanism on the nut itself. Using this nut would be the same as putting vital

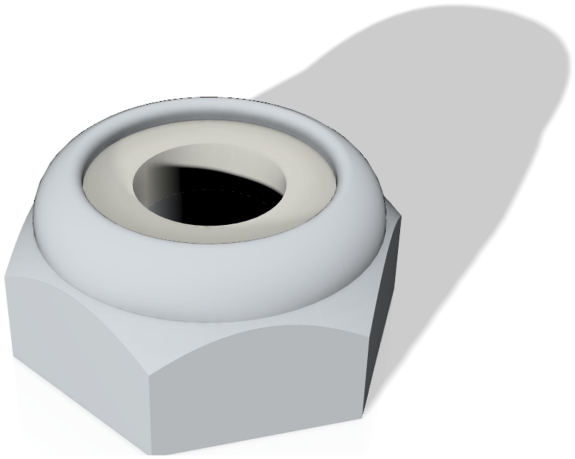


Fig. 2: The Proposed Pneumatic Locknut

subsystems at the mercy of chance. Some solutions have arisen, such as over-tightening these nuts, using an oversized nut retainer, and using a larger locknut meant for #8-32 screws, but all of these have their flaws. Overtightening will eventually diminish in strength, nut retainers are not the right size and don't work in all scenarios, and using a larger locknut could result in the locknut falling off.

The improvement of a pneumatic locknut eliminates the need for unstable and easily-affected nuts used in pneumatics. This gives teams peace of mind knowing that some of their most important subsystems won't come loose.

Design Process-

To start the design process of this nut, I thought of some criteria for a good pneumatic locknut. After brainstorming, I ended up with a low-profile locknut with the outer profile matching a regular VEX locknut (so a regular VEX wrench can be used for tightening) and the inner diameter matching the screw diameter of a pneumatic cylinder.

For this project, I used Fusion 360. I used Fusion 360 because of my experience with the software, the versatility that it provides, and the built-in tools to help present designs and data elegantly and professionally. In Fusion 360 (version 2.0.15023 x86_64), I started the design of the nut by moving a regular pneumatic nut and a low profile #8-32 nut into the workspace. The low-profile locknut is small, uses the same wrench as a regular nut, and most importantly, is a locknut. **The difference between a regular nut and a locknut is a nylon disk at the tip of a locknut. This disk allows for the screw to be essentially grabbed by the nut, ensuring it cannot come loose. A good example of this would be holding a pencil in your hand. If you have a loose grip, the pencil can slide around. If you have a stronger grip, the pencil cannot slip in and out of your hand. The nylon disk (in this metaphor) would be a stronger grip. This disk is the most important part of our nut, as without it, we cannot ensure that the nut will not come off of the piston.** This nut is the perfect nut to turn into a pneumatic locknut. I took measurements of the screw-hole diameter of both nuts. Next, I used the press-pull tool to change the diameter of the low-profile locknut to the pneumatic nuts' diameter. The final step would be to add threads to this locknut. To achieve this, I used the split body tool to split

the nut into three main parts: the exterior, the nylon disk, and the (soon-to-be) threads. Next, I used the press-pull tool to widen the hole by .164 inches, which is how much space the threads will take up. Finally, the thread tool. I used the #8 size (.164") threads, which matched up with the piston's threads.

Specifications-

This locknut is .173 inches tall, .369 inches wide (at its widest point), and .32 inches long (at its longest point). This locknut's exterior hexagonal profiles match the ones of a regular vex locknut (.196 per side), making this nut

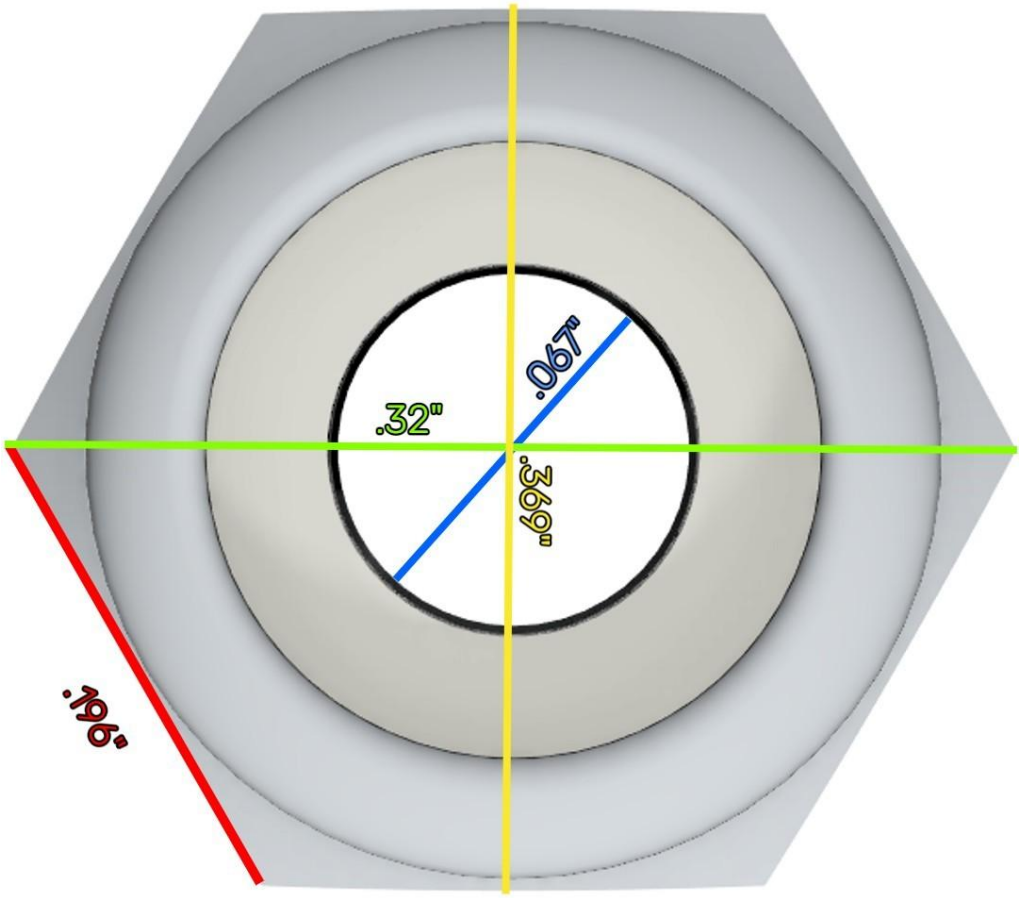


Fig. 3: A Diagram of the Pneumatic Locknut

compatible with tools already owned by robotics teams. This makes tightening easier and more convenient for teams. The threaded segment is compatible with .067” diameter screws, the same diameter as the pneumatic cylinder.

Conclusion-

To summarize, I used existing CAD models in combination with Fusion 360’s built-in tools (Measure, Press Pull, Create Thread, etc.) to create this pneumatic locknut.

I have learned a lot from this project. Whether it be the new tools or design strategies, I have walked away from this simple project with much more than a simple nut. I feel that my future will be in the field of engineering. In engineering, knowing how to use CAD software is a very, very important skill. CAD allows engineers to virtually build their robots without using physical materials (and in a shorter amount of time). Engineers can also simulate stress and aerodynamics without spending unimaginable amounts of money for access to a physical testing laboratory. I haven't only expanded my horizons in my CAD knowledge,

but in my problem-solving as well. Knowing how to problem-solve is a very, very useful skill in engineering and life. I believe that knowing how to problem-solve is the first step to becoming independent and successful. Overall, this project has not only improved the versatility of pneumatics but my mind as well. *Now, teams don't need to put their subsystems at the mercy of chance* and can rest easy knowing that performance will not be jeopardized by an inadequate nut.