**CAD Challenge – Team 2014F, Sandpiper Hexperts**

**Introduction**

Our team has competed in VEX robotics for five years and has found that securing gears and axles in place using a rubber shaft collar is fundamental in building a robot. The problem is that rubber shaft collars are difficult to remove, or move, and we cannot count the number of times that we have injured fingers trying to remove them, not to mention the wasted time. We designed the Shaft Collar Remover to solve this issue, so that shaft collars can be removed or moved safely, effectively and efficiently.

**Shaft Collar Remover**

 The Shaft Collar Remover is a simple, practical and innovative design that removes shaft collars in seconds. As shown in our companion video and photos, the Shaft Collar Remover is a scissor-like mechanism that resembles pliers and that performs the same, basic function. However, unlike pliers, the Shaft Collar Remover is made of plastic, and it will not damage the metal axle or the rubber shaft collar. To use the Shaft Collar Remover, simply hold the axle with one hand and clamp the Shaft Collar Remover around the axle next to the shaft collar. Then, pull the hand with the Shaft Collar Remover and remove the shaft collar easily. The Shaft Collar Remover can be used for removing or simply shifting around shaft collars.

 We used **Tinkercad (Autodesk Tinkercad version 2019\_10\_14)** to create the Shaft Collar Remover because of its easy to use interface. By using a combination of two, half-circles linked to two, oblong shaped rods that criss-cross on a hinge, we created the Shaft Collar Remover from simple shapes. A major challenge in creating the Shaft Collar Remover was designing the pivot screw, the piece that holds the two rods together in a criss-cross alignment and allows the Shaft Collar Remover to move in a scissor-like fashion. The design process for the Shaft Collar Remover was time-consuming and required many iterations, which stretched the limits of our creativity, while also teaching us perseverance and patience.

 Ultimately, we decided on the current design because of three factors: 1) importance; 2) simplicity; and 3) practicality. The Shaft Collar Remover could serve as an important tool in the robot building process, because it would be used regularly by students when building and making changes to their robot design. In addition, because of the simplicity of the design, even young or novice, robotics students can use it and will not have to struggle to learn how the Shaft Collar Remover works. Finally, the Shaft Collar Remover is a practical tool, because it will allow for the safe and quick removal or adjustment of shaft collars on axles.

**Conclusion**

Creating the Shaft Collar Remover and using Tinkercad was an enjoyable and creative process that pushed the limits of our imaginations. Having completed this challenge, we feel confident that we can use Tinkercad as a great resource in the future to design and create similar projects. Some of us are eighth graders who seek to attend a high school that focuses on technology, Design Tech High School in Redwood Shores, California. In addition to learning core subjects such as math, English, history and science, Design Tech requires high school students to complete four years of study in “design labs.” Completing this challenge has given us confidence to tackle our high school curriculum. Beyond high school, however, the knowledge that we learned from completing this challenge will help us in our future careers, whether we choose to pursue careers in technology, medicine or virtually any path. Understanding how a part is designed is fundamental to understanding its many potential uses. This is our team’s last year of eligibility for the VEX IQ program, but we plan to continue to compete in VEX Robotics in the VRC program, where designing and creating your own parts is vital in building your robot and creating a successful robotics team.