

# Passive Capture Tool Dock (PCTD)

Magaly Chavarria, Cal Harper, Julien Hebert, Vivian Luu, Garrett Stevens  
Mechanical Engineering Program – College of Science and Engineering



## ABSTRACT

During Extravehicular Activities (EVA's), astronauts use the Pistol Grip Tool for essential maintenance tasks. The current Bayonet and Tether system used for securing this tool requires visual confirmation and two-handed operation, increasing the risk of tool loss. To address this issue, Team Interstellar Innovators designed the Side Release Buckle, a compact and easy to use docking system that allows one handed operation without visual checks. This design improves safety, saves time, and makes tool handling more efficient during spacewalks.

## Project Background

Losing tools and materials in space can be extremely hazardous for astronauts, the International Space Station, and even for other orbiting satellites.

Currently NASA uses a tool called the Bayonet to secure tools to the astronaut. This device is not single fault tolerant and requires additional tethers to safely secure tools in the event of a component failure [1].

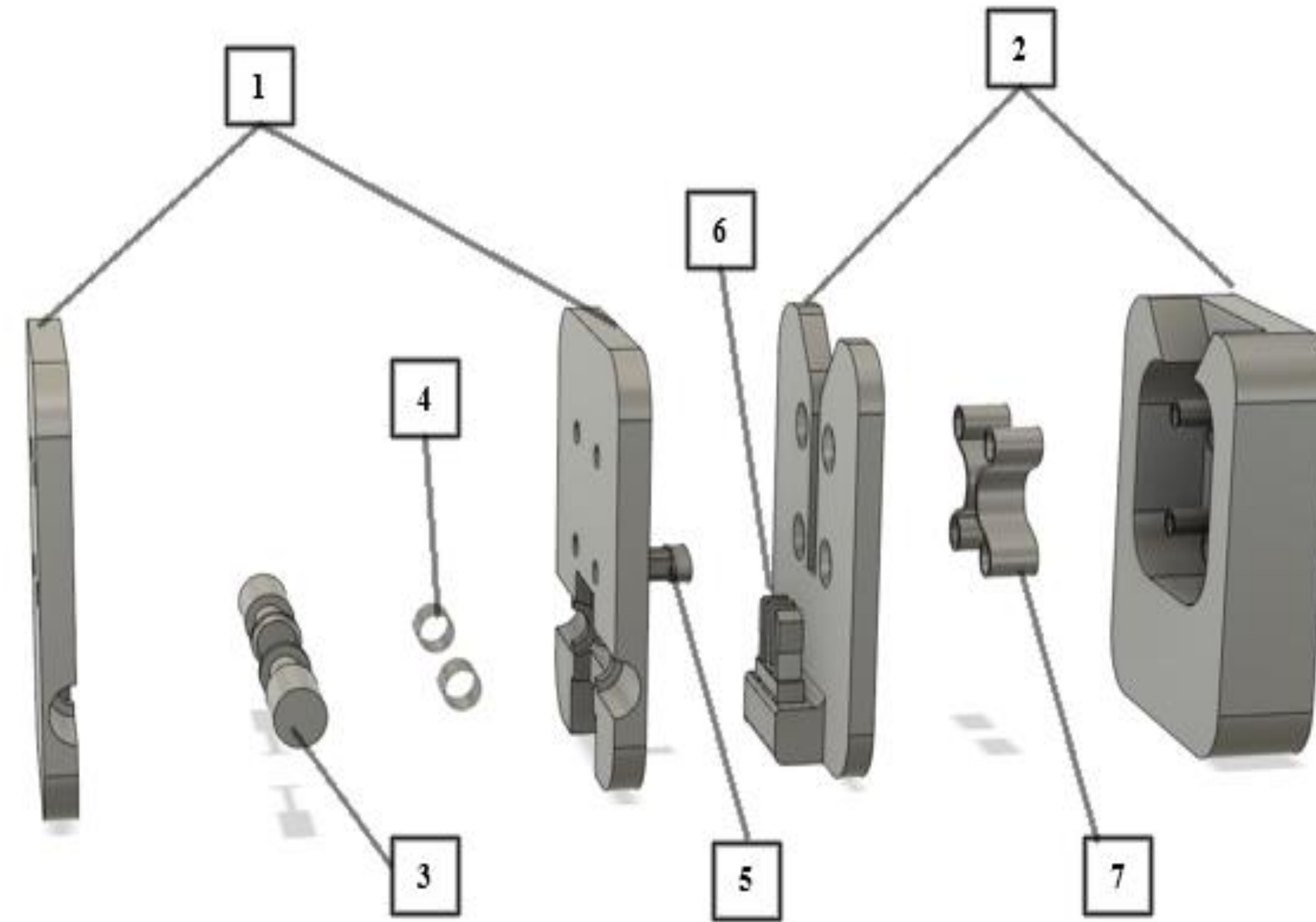
To better secure tools and materials during EVAs NASA is looking for alternative methods to secure the Pistol Grip Tool (PGT) one of the largest and most frequently used tools used by astronauts.

## Objectives

To design a Passive Capture Tool Dock that safely and securely holds the Pistol Grip Tool, while the following requirements are met.

- Blind and One-Handed Installation
- Ergonomic
- Holds at least 15 lbs.
- Less than 10 lbs. and 1.5 lb-in install forces
- Operable in constrained body positions
- Single fault tolerant

## RESULTS & DISCUSSION

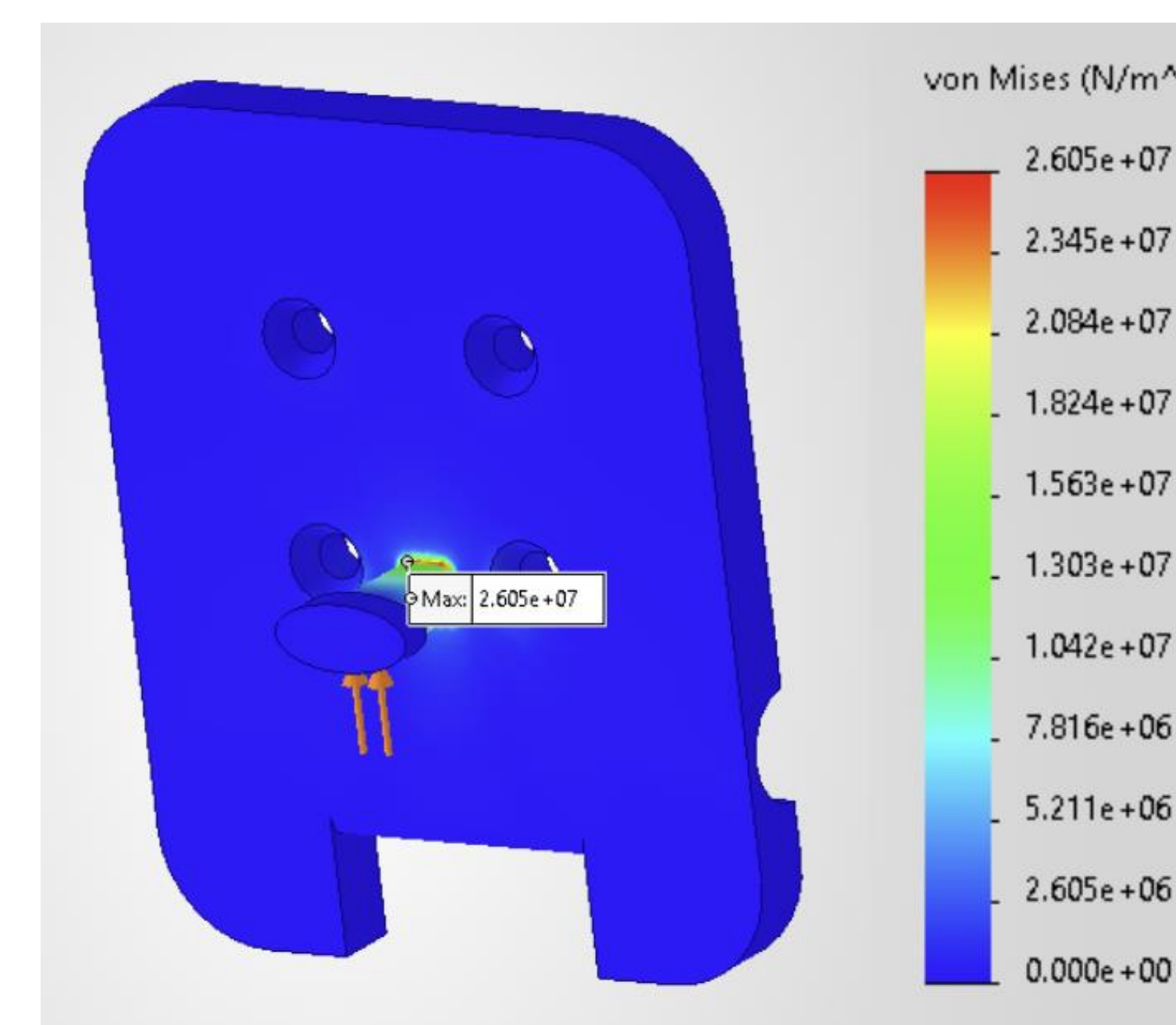
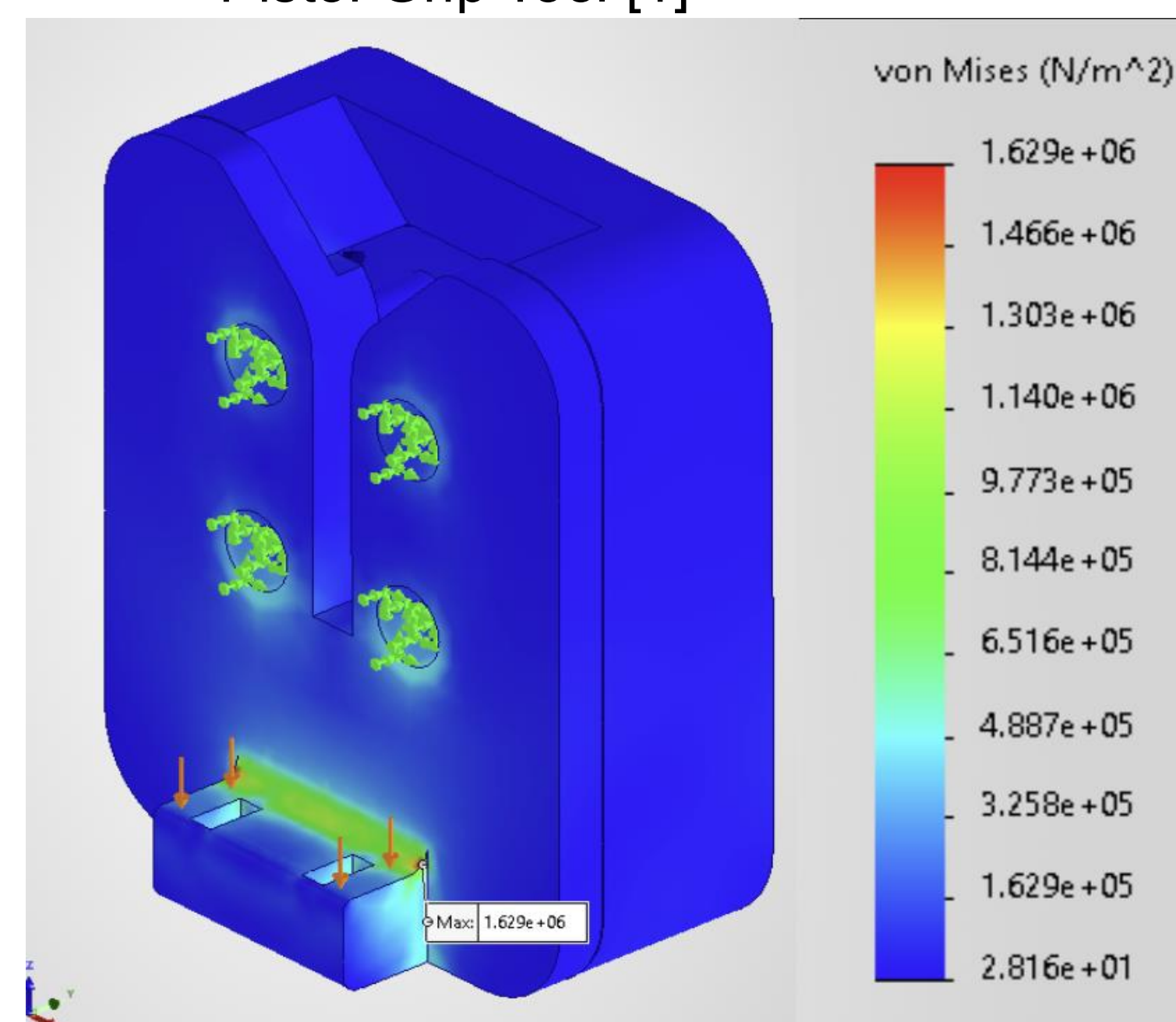
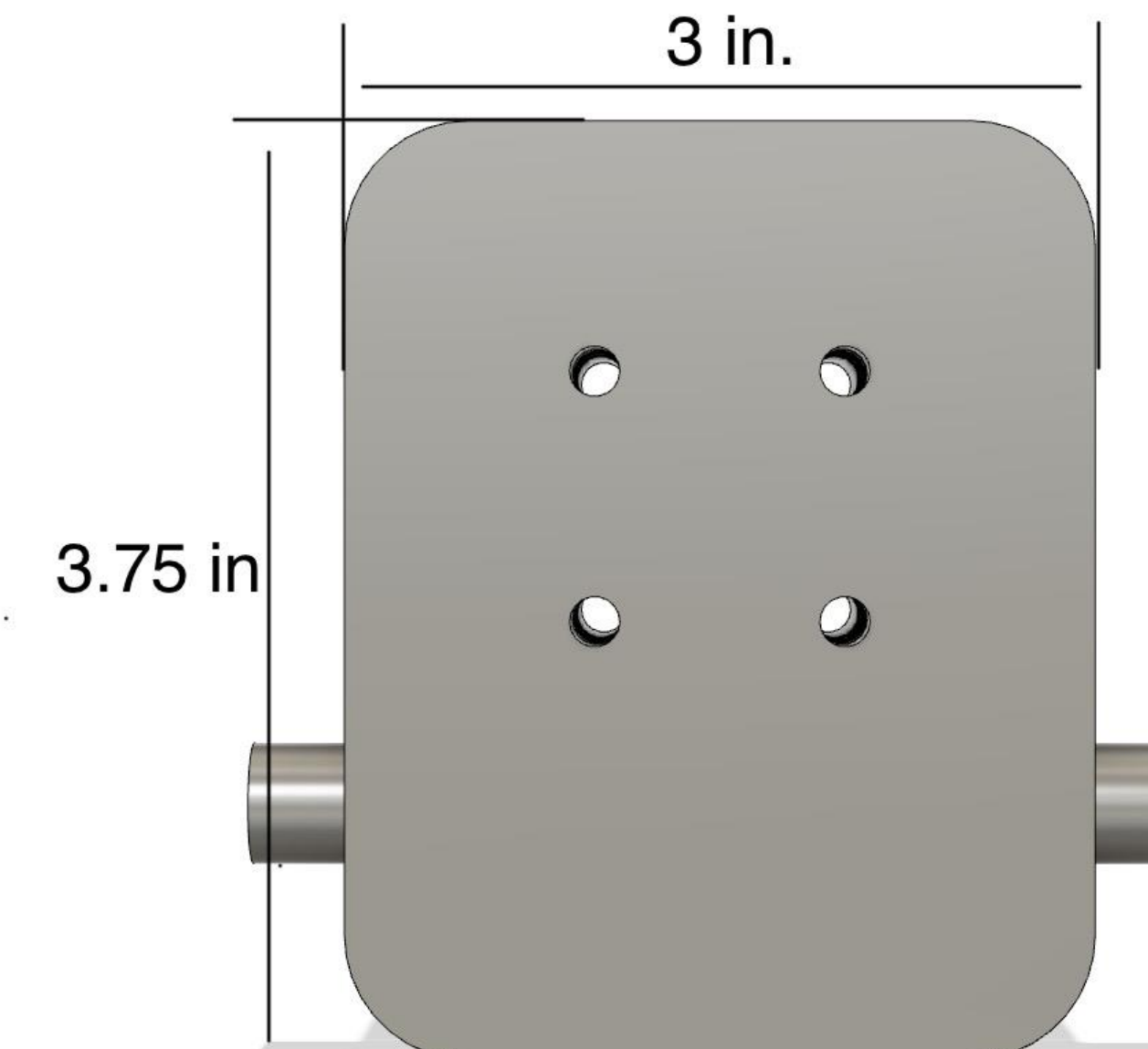
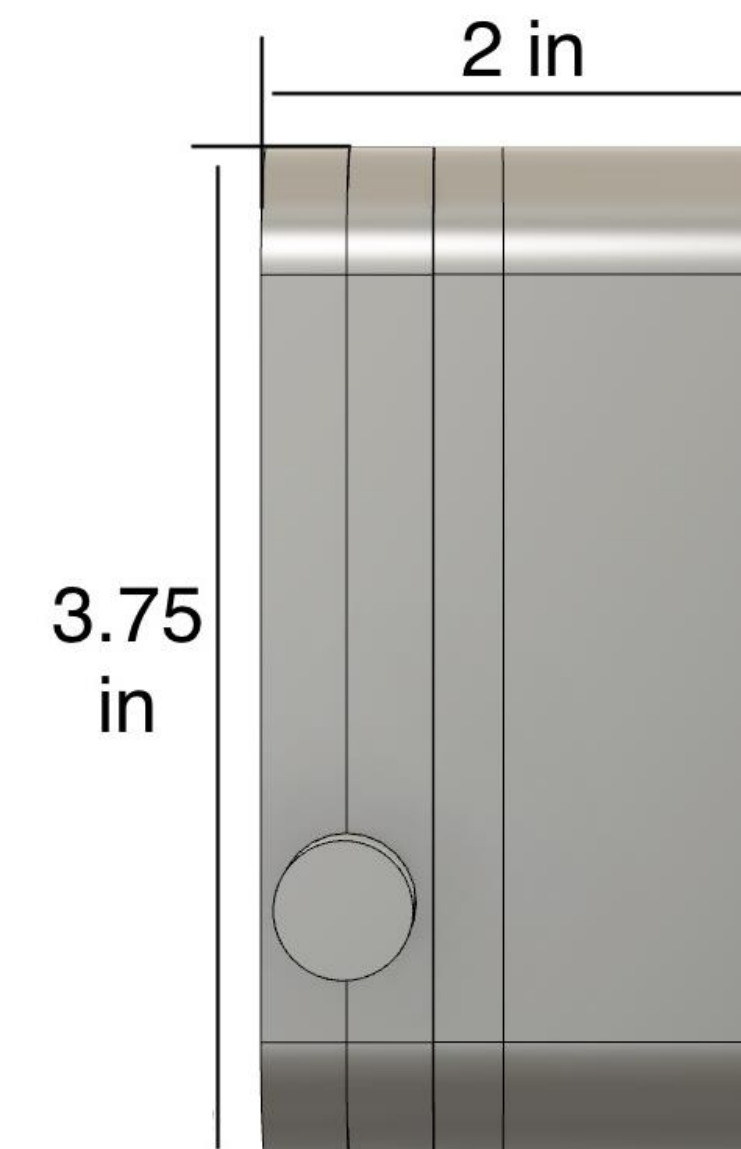


| Item No. | Part                       |
|----------|----------------------------|
| 1        | Body of Tool Component     |
| 2        | Body of the Belt Component |
| 3        | Buttons                    |
| 4        | Springs                    |
| 5        | Pin                        |
| 6        | Buckle                     |
| 7        | Curved Flat Springs        |

Bayonet



Pistol Grip Tool [1]



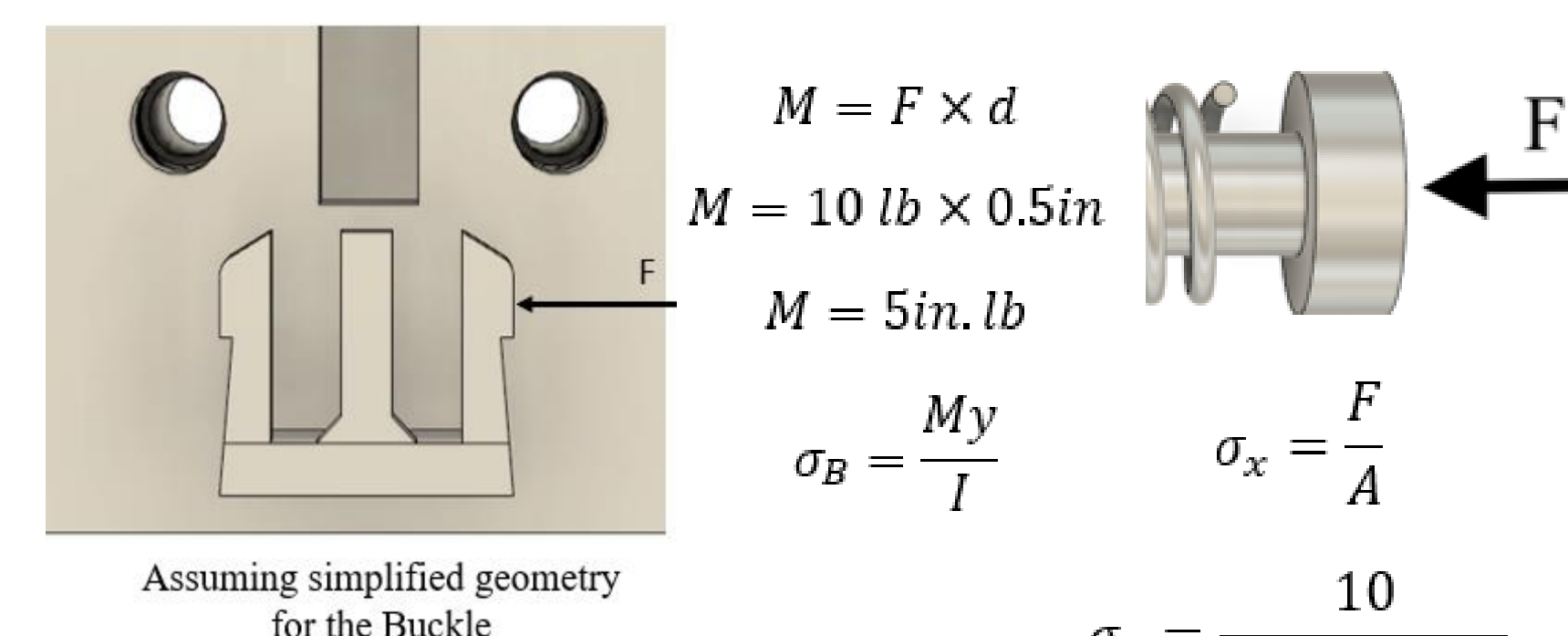
## PCTD SPECIFICATIONS

Mass = 0.535 lbs.

Install Force = TBD

Separation Force = TBD

## Button and Buckle Analysis



$$M = F \times d$$

$$M = 10 \text{ lb} \times 0.5 \text{ in}$$

$$M = 5 \text{ in. lb}$$

$$\sigma_B = \frac{My}{I}$$

$$\sigma_B = \frac{5 \text{ in. lb} \times 0.49 \text{ in}}{\frac{1}{12} \times 0.125 \text{ in} \times 0.98^3 \text{ in}^3}$$

$$\sigma_B = 25.0 \text{ kpsi}$$

$$\sigma_x = \frac{F}{A}$$

$$\sigma_x = \frac{10}{\frac{\pi}{4} \cdot (0.125)^2}$$

$$\sigma_x = 6.5 \text{ kpsi}$$

## TESTING

Creep Testing: Ongoing

PCTD holds PGT equivalent mass successfully

Fatigue Testing: Ongoing

Ease of Use/Ergonomic:

PCTD is operable simulating astronaut gloves

Single Fault Tolerance:

PCTD continues to operate when either the flat springs or buckle are removed

## CONCLUSIONS

Although the Side Release Buckle uses an alternative material, it does successfully meet NASA's functional objectives by allowing easy one-handed tool docking without visual confirmation. This PCTD supports loads of 15 lbs. with a factor of safety above 2.0, while remaining below the 2 lb. weight limit. The compact design is ergonomic and compatible with EVA gloves for ease of use. By using third party buckles the design can be easily altered with alternative materials. Overall, the design meets NASA's goals for improving astronaut safety, efficiency, and reliability during spacewalks.

## Acknowledgements

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## References

Email Cal Harper for any questions  
(HarperC2356@uhcl.edu)

[1] Peterson, Adam. "NASA's Micro-g next Challenge Info Session." Box.com, NASA, 2025, nasaext.app.box.com/s/x7j1brau2o1098a3um15i8wuqy0qvuma/file/1998194485348. Accessed 12 Oct. 2025.

[2] NASA, "NASA Spaceflight Human System Standard Volume 2: Human Factors, Habitability, and Environmental Health," NASA-STD-3001 Vol. 2, May 29, 2025. [Online]. Available: <https://www.nasa.gov/reference/nasa-std-3001v2/>