Astro Attach Softgoods Attachment Device

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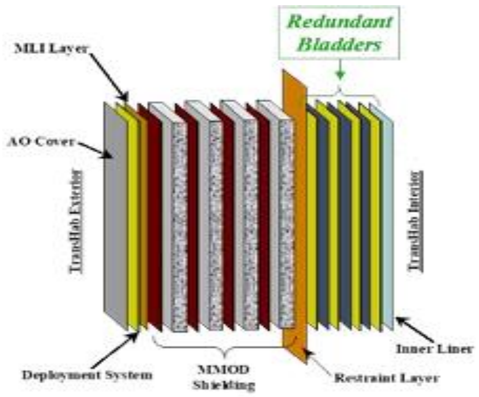
ABSTRACT

Softgoods are selected for their durability and protective capabilities, which are crucial for safeguarding sensitive equipment during extravehicular activities. However, astronauts often struggle with limited mobility in their space suits, making it challenging to properly attach or adjust softgoods when maintenance or replacement of sensitive equipment is necessary. Team Astro Apollo's main goal was to develop an innovative solution to overcome this obstacle.

Project Background

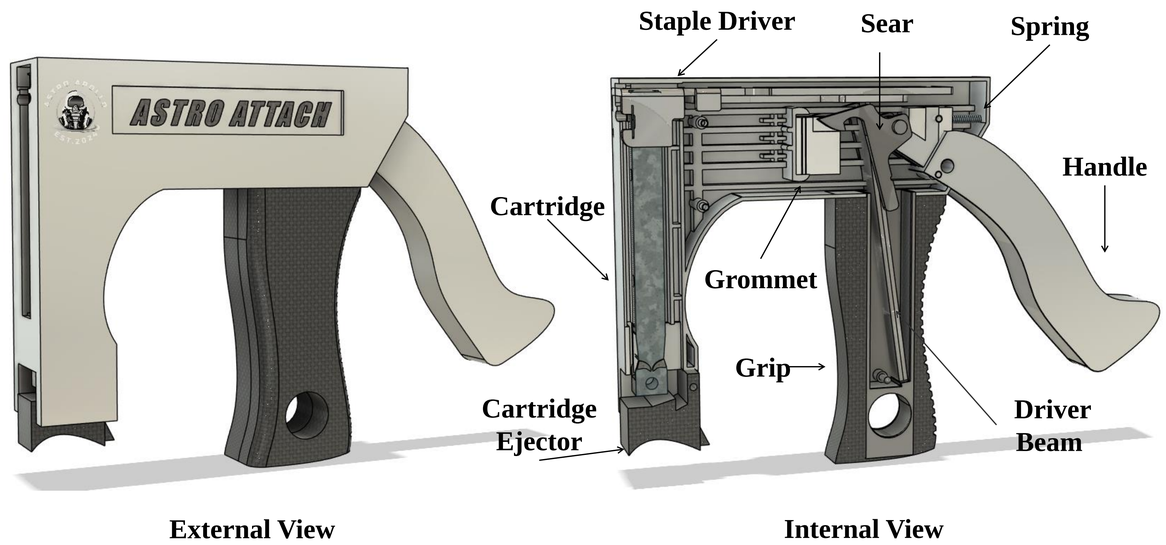
Softgoods play a crucial role during space exploration missions, by providing protection to astronauts and the structure of spacecrafts/satellites. Softgoods provide thermal insulation and protection against debris for many sensitive equipment which shows the importance of this technology.



Objective

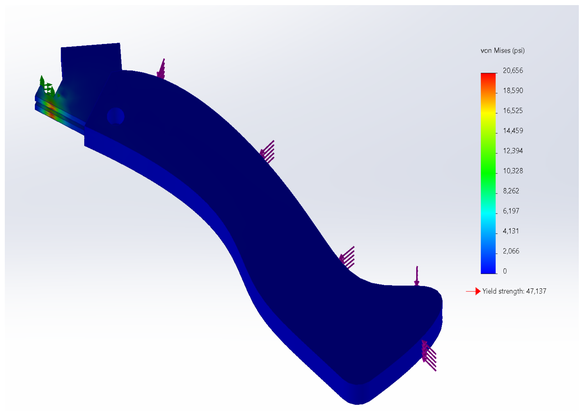
The primary objective was to design a tool that enables astronauts to efficiently and securely attach overlapping pieces of softgoods. The tool's design takes into account the limited mobility and dexterity astronauts experience while in spacesuits. The key benefits this device offers to the industry are its reliability and effectiveness, which would facilitate broader use of softgoods for structural applications and other components.

Astro Attach Exterior & Internals



Design Analysis & Results

The team performed a finite element analysis on the Astro Attach handle to evaluate its strength and durability. Preventing failure is a top priority, and the results of this analysis confirm the effectiveness of our material selection and design approach.



Specifications	Value
Handle Weight	1.03 lbs
Handle Dimensions	7.79in x 1in x 3.28in
Handle length	5.8 in
Max handle stress	21 ksi
Internal bar max deflection	.32 in
Driver force	46 lbs
Body/handle material	2024-T4 Aluminum

Calculations

A key component of the attaching mechanism of the device is the internal metal beam which is deflected when pressing the handle. The driving force that results from this action is what is used to drive the staples into the softgoods to attach them. The following calculations was done to determined the deflection.

$$\delta = \frac{F_2(l)^3}{3EI} = \frac{46.4\ lbf * 6.2in}{3 * (29 * 10^6)psi * .0004\ in^4} = .32 \text{ in}$$

Design Specifications

Specification	Description
Dexterity	Ambidextrous Design
Ergonomic	Grip & Handle Design
Operation	Mechanical
Material	2024-T4 Aluminum

Specification	Value	Unit of Measure
Device Dimensions	11 x 8.3 x 2	inches
Weight	6	lbs
Staple Size	0.5	inches
Capacity	75	Staples
Staple Force	10	lbs

CONCLUSIONS

The Astro Attach device makes attaching overlapping Softgoods simple and easy by prioritizing ease of use and ergonomics that ensure an astronaut with limited mobility and dexterity can perform the attachment task. EVA missions using the Astro Attach device will be improved upon by having a more efficient and reliable method of attaching softgoods together when needed.

Acknowledgements

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References

[1] *Intelligent flexible materials for space structures*. Available at: https://ntrs.nasa.gov/api/citations/20100017479/downloads/20100017479.pdf