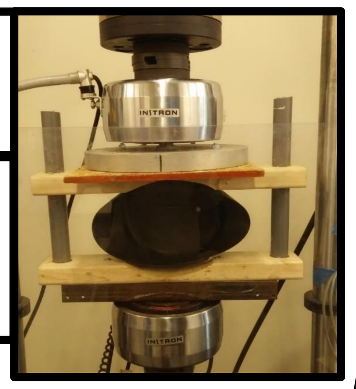
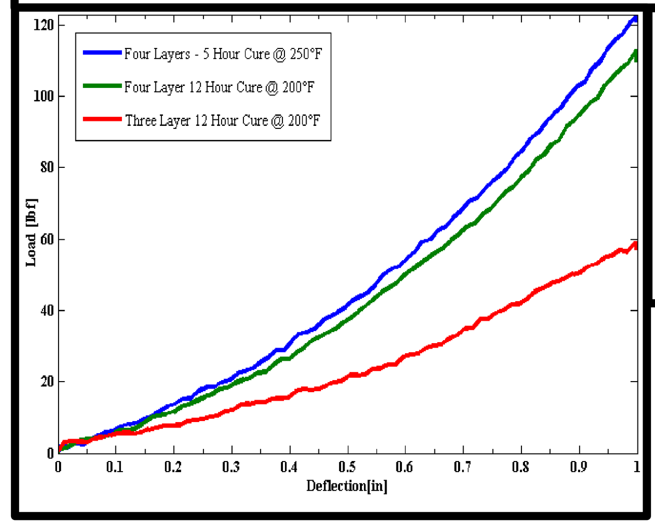
Testing

Instron Compressive Testing



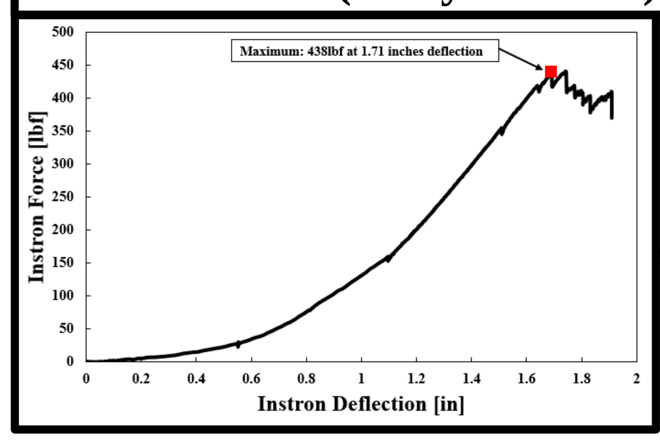
Instron testing was performed to characterize our canister and to test variables such as cure temperature, cure time, and wall thickness.

Effect of Autoclave Cure Cycle on Half Canister (Force-Deflection Curve)



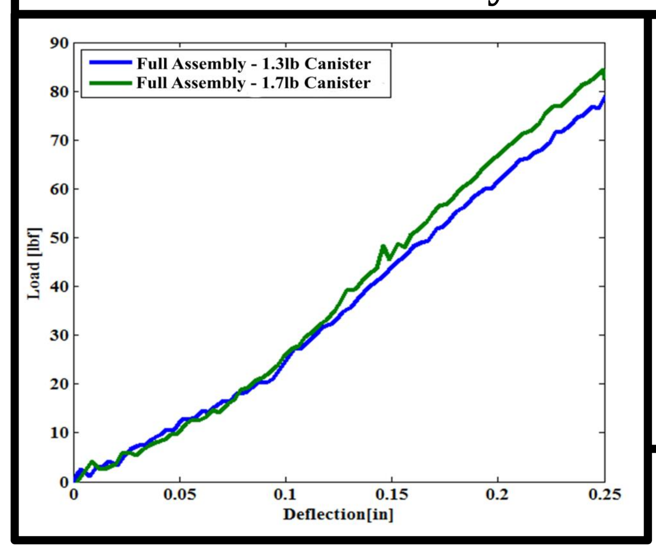
A shorter cure cycle at higher temperatures was found to be stiffer than a longer cure cycle at lower temperatures.

Half Canister Instron Force-Deflection Curve (4 Layer Model)



A half canister was taken to failure to demonstrate the strength and elasticity of our composite canister

Full Canister Assembly Force-Deflection Curve



The center stiffening ring is designed to support the majority of the radial load. The entire assembly, featuring the ring and two halves, supported 84 lbs at a quarter inch of deflection

Drop Test

A drop test simulated a bear pouncing on the canister. 100 lbs was dropped on the canister top and side from 1 ft high. Both the 1.3 lbs and 1.7 lbs canisters passed the top drop test. Neither passed the side test.

	1.7 lbs Canister (4 Layers)	1.3 lbs Canister (3 Layers)
Top Drop Test	Passed	Passed
Side Drop Test	Plausible	Failed

Conclusion

The heavy canister failed with plausibility because all structural parts remained intact; the bolt holes shearing was the only failure. When both canister halves were bonded to the stiffening ring, the epoxy seal was the only failure. All drop test failures were due to an underestimation of the impact time and stress concentrations. We believe our design is an elegant and robust option that will succeed after future iterations.

Introduction

Problem Statement

A full attachment-locking mechanism is to be designed for the bear canister. This includes the interface between the mechanism and the canister body, and the structure of the assembly so it passes the strength and weight specifications.

Calling all ultralighters!

- Ultralighting is a niche category of backpacking.
- Ultralighters are willing to sacrifice anything including money and comfort for lighter products.
- Ultalighters are in need of a lighter bear canister.

A bear canister's purpose

- Protects a backpacker's food from bears
- Keeps bears wild (and alive)
- Are required in national parks in California, Alaska, Montana, Colorado, New York, Washington and Wyoming

Specifications

Specification	Target	Our Canisters
Total Weight	1.3 lb	1.3 lb & 1.7 lb
Internal Volume	650 in³	668 in³
Total Budget	$2000	$450
Drop Test Weight	100 lb	Fail
Live Bear Test Time	60 min	n/a

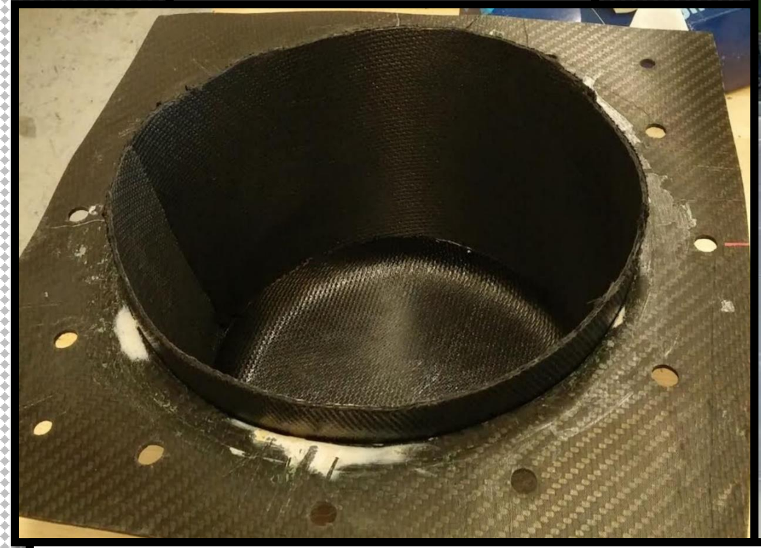
BEAR MINIMUM

ADAM EISENBARTH RAMA ADAJIAN

ME SENIOR PROJECT 2017

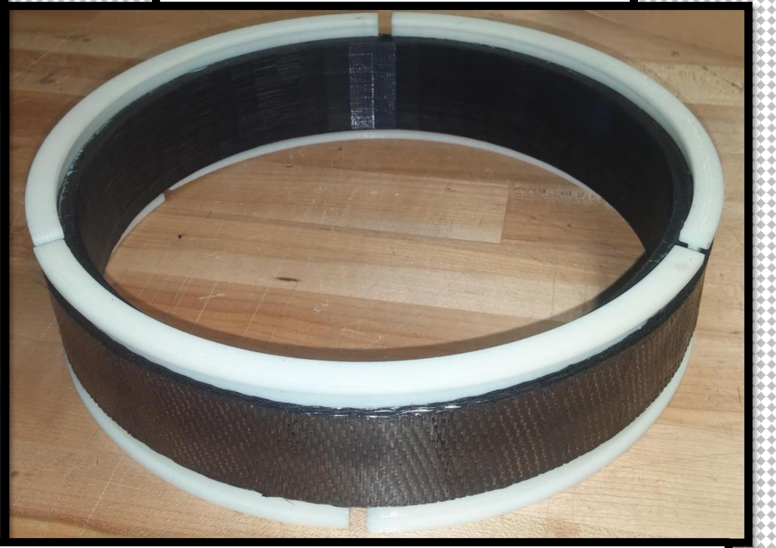
Manufacturing

Canister Half



Final Assembly

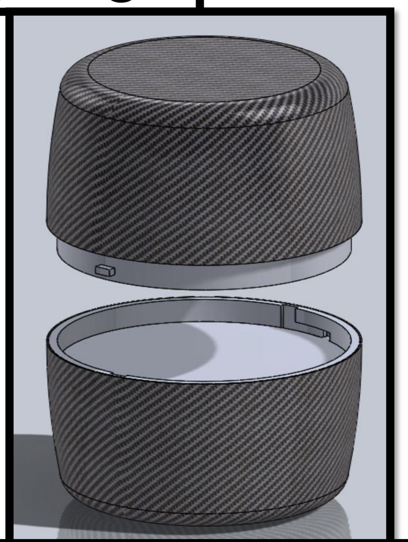
Stiffening Ring

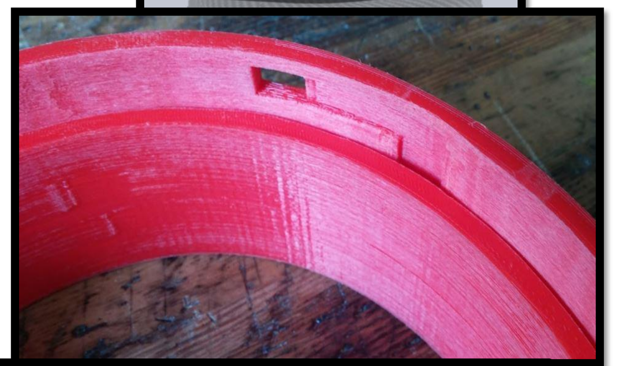


- The final assembly consists of two canister halves, the stiffening ring, thumb screws & reciprocating nuts to lock the canister, and a retaining net Velcroed in for packing convenience.
- Four stiffening ring manufacturing iterations were completed due to the complex geometry.
- The stiffening ring mold was 3D-printed out of ABS and was dissolved in acetone post-cure.
- Two final prototypes were made: a 3-layered (1.3 lbs) and a 4-layered canister (1.7 lbs).

Design

Conceptual Designing

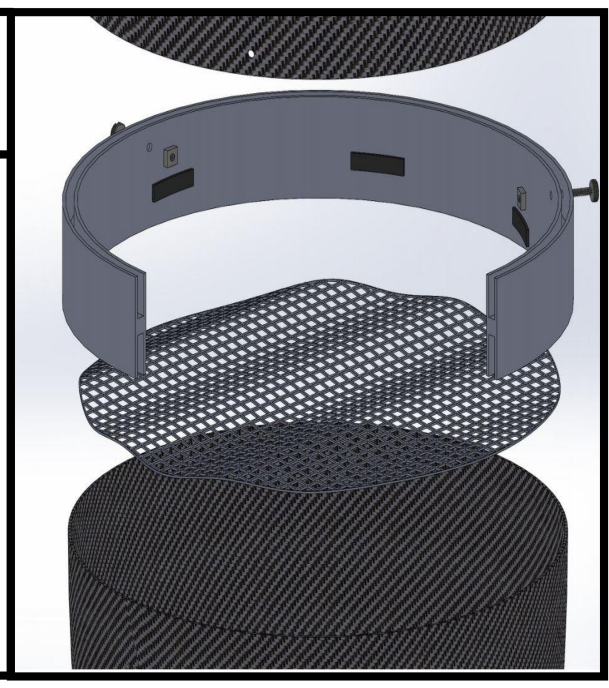




Once design specifications were defined, multiple idea generation sessions were conducted. Possible designs were categorized as a top-opening design or a middle-opening design. Sample designs of each are shown above.

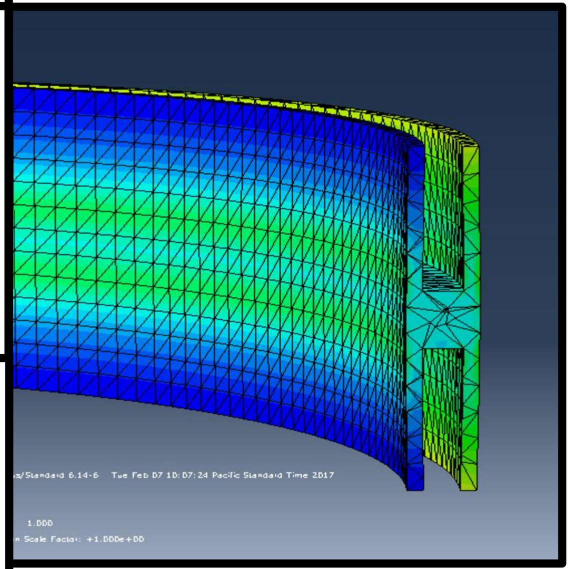
Final Design

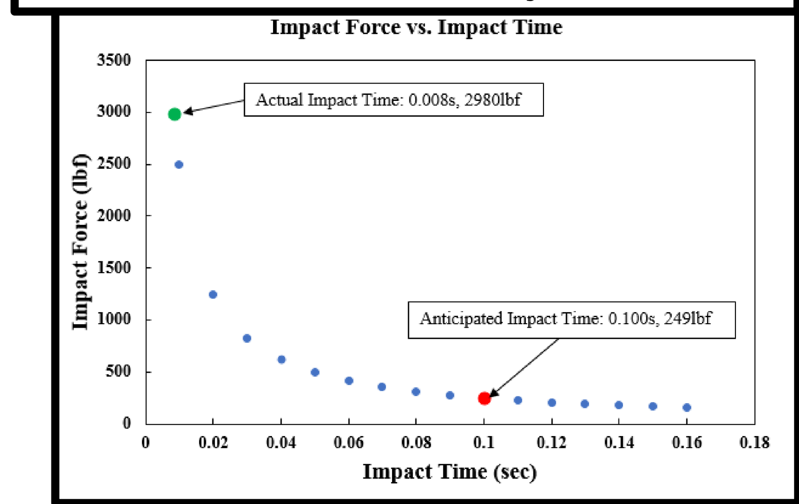
Our final selected design features a stiffening ring responsible for attaching the canister and transferring loads between the two halves. The stiffening ring features two tongue-and-groove connections interfacing with the canister halves.



Justification

Stresses in the canister were calculated from an impact analysis. Finite Element Analysis (FEA) was used to help design the canister to take an impact load of 249lbf with a 1.49 safety factor.





Acknowledgements

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