HOLD DOWN AND RELEASE MECHANISM (HDRM)

Sponsored by General Atomics- Electromagnetic Systems

Team 4: STELLARHOLD- Valentin Gamez, Nathan Olson, Maia Warren

PROJECT DESCRIPTION

- General Atomics- *Energy and Defense Corporation* (Nuclear Research/development)
- HDRM serves as part of GA-EMS spacecraft in-house mission

- sponsored by GA

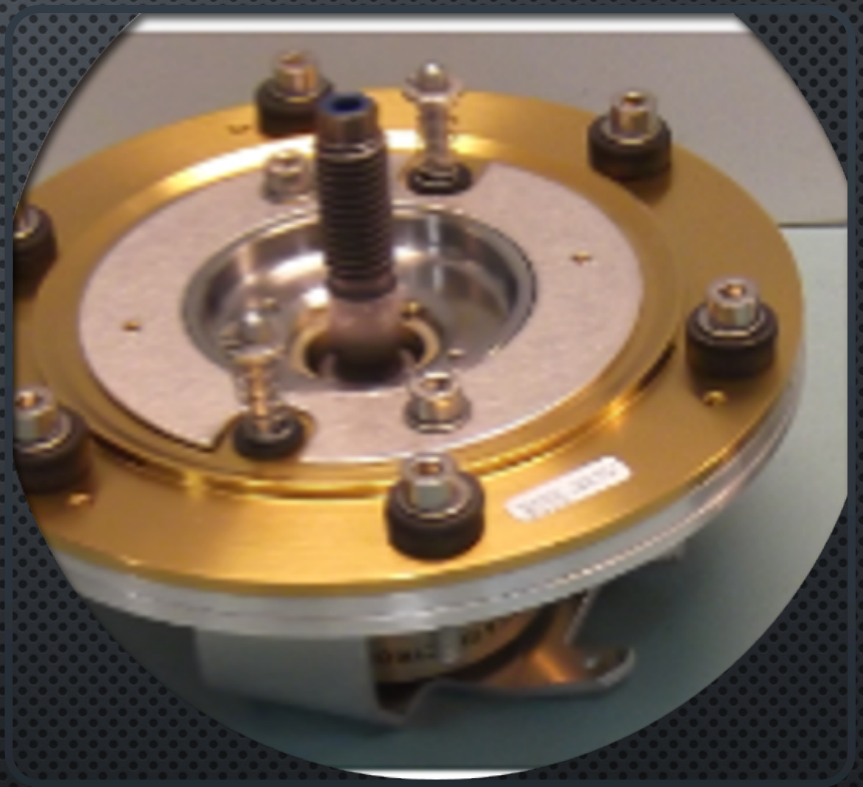
- supplies to GA by outside vendors (*beginning in-house development*)

- Parts stowed during deployment, released once in orbit (*detumble stage*)

- solar panel arrays, rolls, antennas, etc.

- put on a 12U CubeSat (20cm x 20 cm x 30 cm) (10 mm-iceberg)

- Why are HDRMs needed? (Hold down, Release)



BLACK BOX MODEL

Figure 1: Black Box Model

DECOMPOSITION MODEL

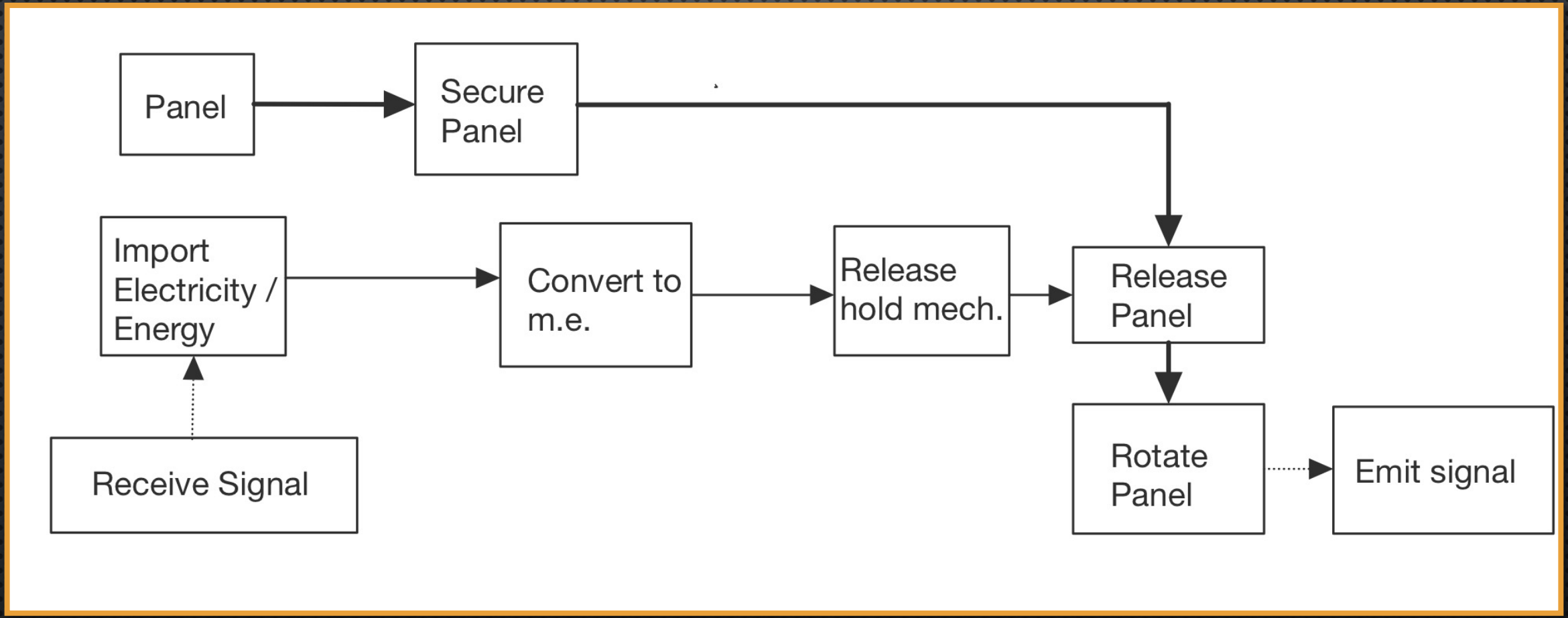


Figure 2: Decomposition Model

CONCEPT GENERATION – MORPH MATRIX

Table1: Morph Matrix

Sub Function	Concept		
Hold Type	Shape Memory	Fuse Wire	Electric Motor
Release Type	Pin Pull	Pin Push	Breaking Bolt
Reset Mechanism	By Hand - Reset	Secondary Device	By hand - Replace
Containment Type	None	Attachable	Built-in
Actuation/Trigger	Timer	Sequence Activated	Radio Receiver

DESIGN 2 – THE ACTUATOR

- Must retain load and release it upon triggering
- Wedge separates hold mech – releases pin

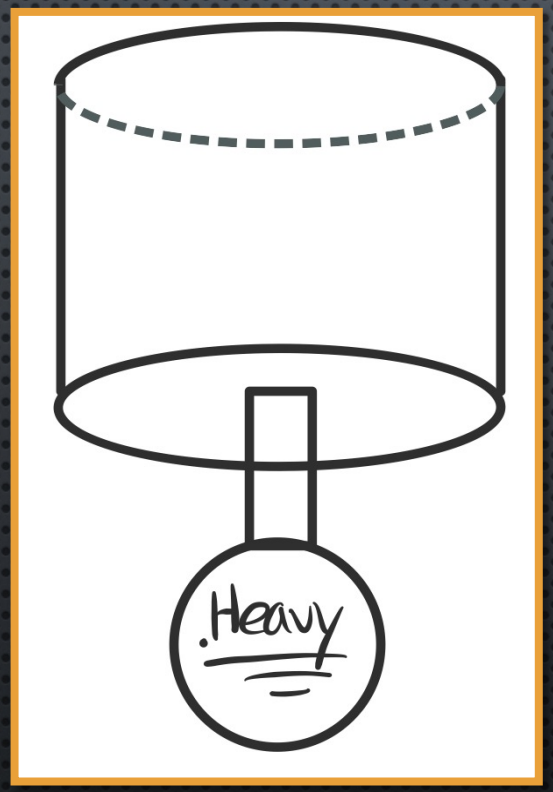


Figure 3: Design 2 pt.1

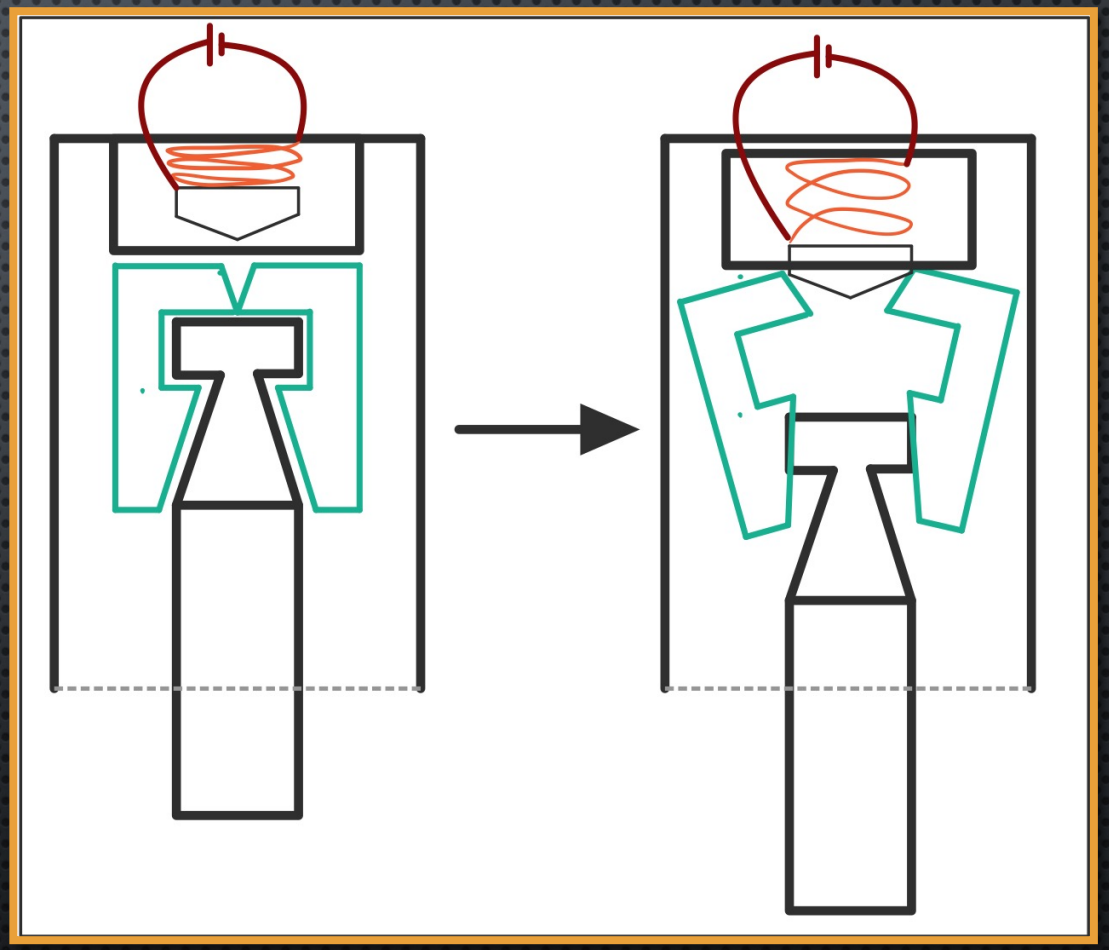


Figure 4: Design 2 pt.2

DESIGN 3 – MINIMALIST

- Shape Memory Alloy
- Pulls pin to trigger release

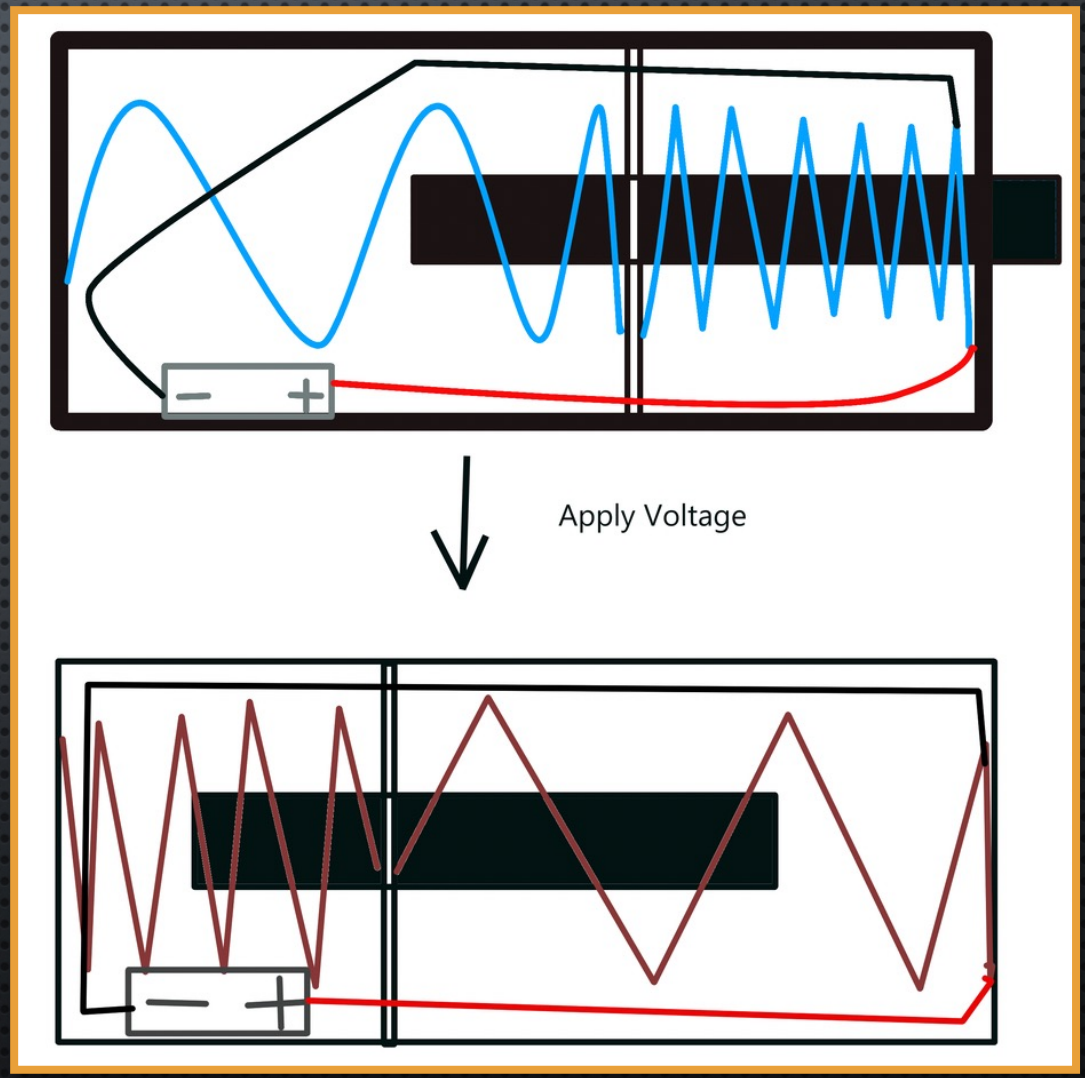


Figure 5: Design 3 Sketch

DESIGN 5 – BOLT BREAKER

- Wire to fracture pin
- Pre-set wire assembly for reset

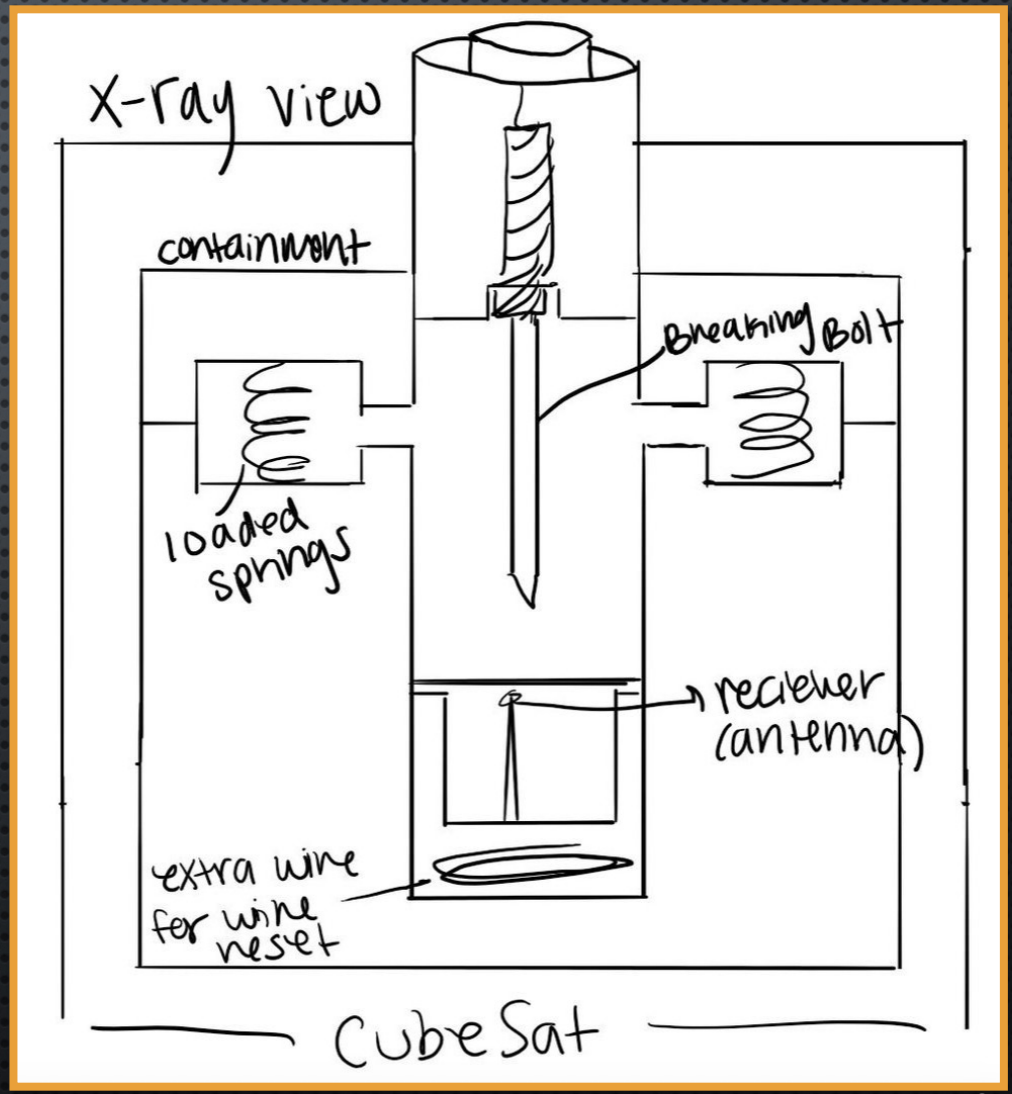


Figure 6: Design 5 Sketch

Table 2: Pugh Chart Legend

Design Concepts Legend					
Concepts	Sub Functions				
	Hold Type	Release Type	Reset Mechanism	Containment	Actuation
1	Electric Motor	Breaking Bolt	Manual Replacement	Attachable	Sequence
2	Shape Memory	Pin Push	Manual Reusable	Attachable	Sequence
3	Shape Memory	Pin Pull	Secondary device	None	Sequence
4	Fuse Wire	Pin Pull	Manual Replacement	Built-in	Timer
5	Fuse Wire	Breaking Bolt	Secondary device	Built-in	Radio Receiver
6	Electric Motor	Pin Push	Manual Reusable	None	Timer

CONCEPT EVALUATION - PUGH CHART

Table 3: Pugh Chart

	Concepts					
Selection Criteria	**1**	**2**	**3**	**4**	**5**	**6**
Hold Down	S	+	+	+	+	D
Release	-	S	+	+	-	A
Resetablility	-	S	+	-	+	T
No Space Debris	-	-	S	-	-	U
Actuation	+	+	+	S	+	M
Total +	1	2	4	2	3	0
Total -	3	1	0	2	2	0
Overall Score	-2	1	4	0	1	0

PREVIOUSLY USED DESIGNS

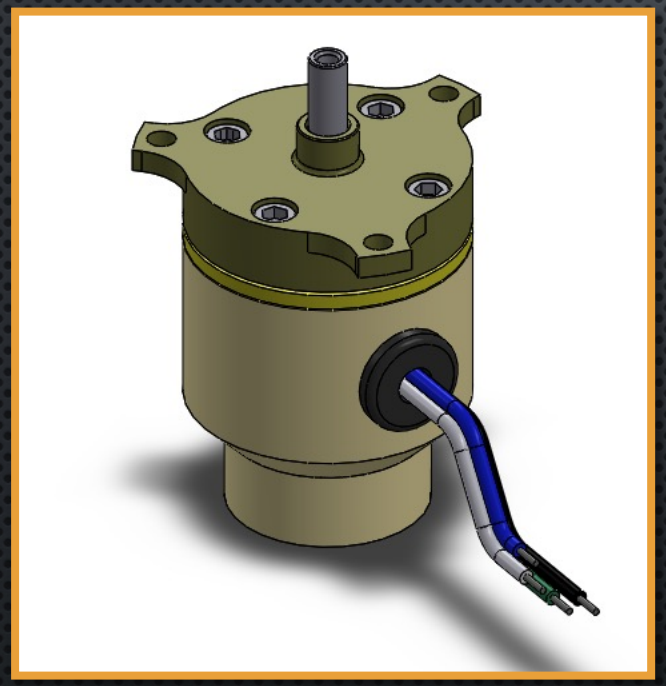


Figure 7: Pin Puller CAD [1]

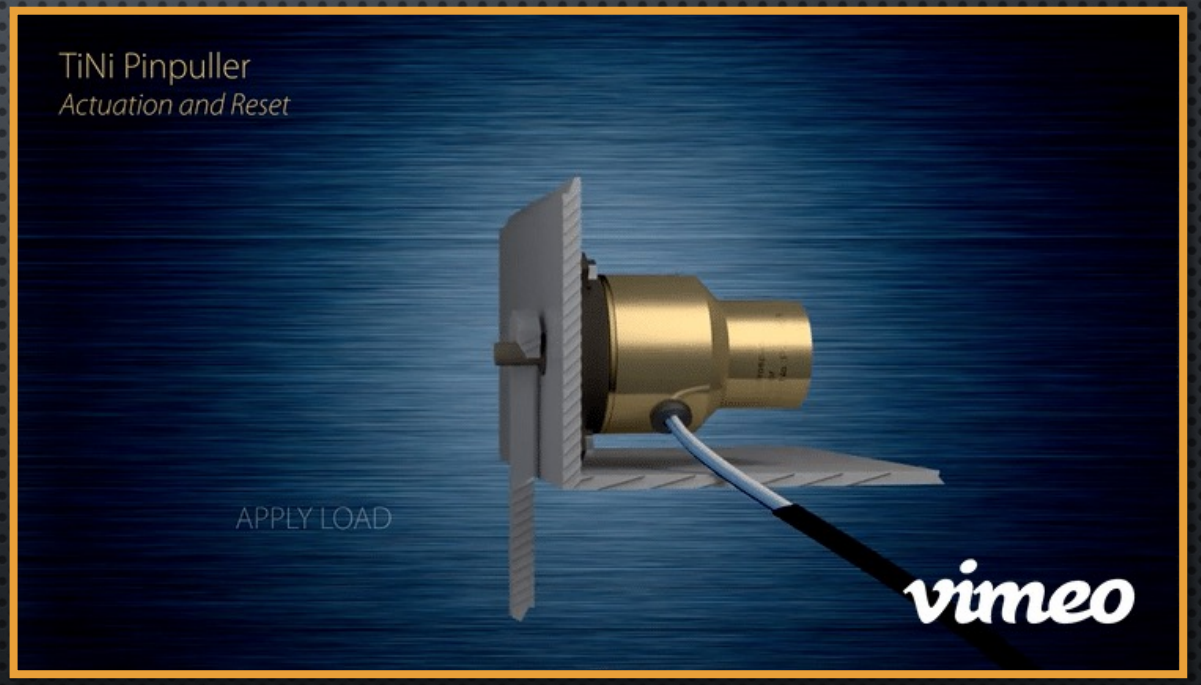


Figure 8: Pin Puller Demo [1]

BUDGET PLANNING: PT 1-BILL OF MATERIALS (PART)

Table 4: Parts BOM

Manufacturing Budget	Testing Budget	Repair Budget
$1,000	$500	$500
	Total:	**$2000**

- Finalized budget: $5,000
  - $2,000 for HDRM
  - $3,000 for Travel

PT 2-BILL OF MATERIALS (TRAVEL)

Table 5: Travel BOM

Item #	Description	Quantity	Cost	Part Number
1	Gas (To/From Phoenix)	1	$50	N/A
2	Parking	5	$14	N/A
3	Flight (Round Trip)	3	$580	N/A
4	Uber (Airport-Hotel)	2	$70	N/A
5	Hotel (2 Rooms)	4	$200	N/A
6	Uber (To/From GA)	N/A	$200	N/A
		Total:	$3,000	

REFERENCES

1. "TINI™ PIN PULLER," *ENSIGN-BICKFORD AEROSPACE & DEFENSE*, 06-DEC-2021. [ONLINE]. AVAILABLE: HTTPS://WWW.EBAD.COM/TINI-PIN-PULLER/. [ACCESSED: 22-FEB-2022].

Thank you!

Questions?

Criterion	Weight	Design 2		Design 3		Design 5	
Hold Type	0.2	90	18	90	18	70	14
Release Type	0.1	85	8.5	100	10	70	7
Resettable	0.2	100	20	90	18	90	18
Containment Type	0.05	80	4	100	5	85	4.25
Actuation/Trigger	0.2	95	19	95	19	100	20
Cost	0.1	100	10	90	9	90	9
Reliability	0.1	95	9.5	95	9.5	90	9
Manufacturing simplicity	0.05	70	3.5	100	5	75	3.75
Totals	1		92.5		93.5		85
Relative Rank			2		1		3