Compact Pneumatic UAV Launcher

FAMU - FSU College of Engineering

Sponsored By Eglin Air Force Base

Launch Team - Group 3

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Overview

- Reasoning
- Design Specifications
- Concept Generation
- Design Functionality
- Testing
- Final Design
- Methods of Improvements

Reasoning

Problem Statement

Eglin Air Force Base needs a safe, efficient, and effective method of launching their current UAV prototype into flight.

Needs Assessment

The objective of this design is to provide a means of propelling an Unmanned Aerial Vehicle (UAV) into flight, which will be provided by Eglin Air Force Base.

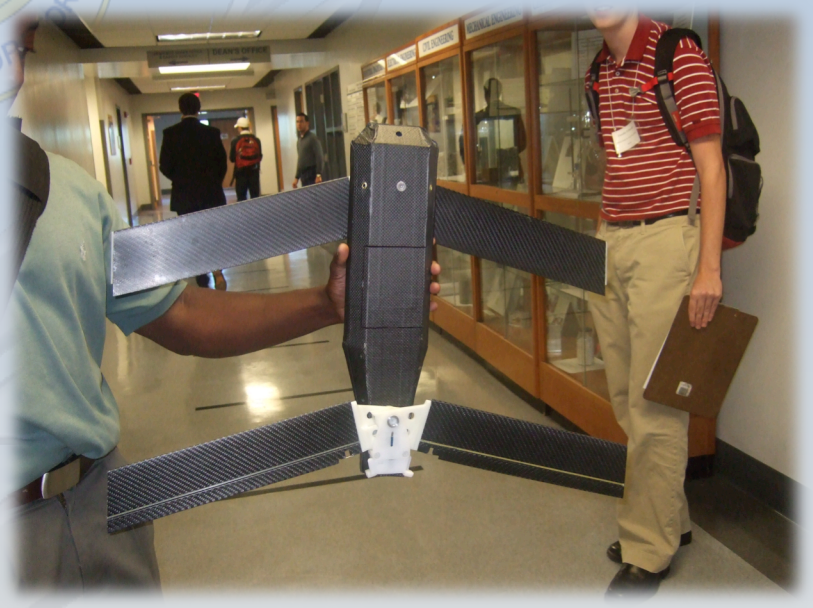
Background

- Currently launched by hand, tubing, or other aircraft
- Methods do not meet the EAFB standards
- Better means of launch must be developed

Design Specifications

Launcher

- 60 ft/sec min exit velocity
- Max 600Gs of instantaneous acc
- Launcher weight limit: 2.5 lbs -> 11 lbs (after written approval)
- Estimated 30-45 deg launch angle
- No energetic methods or accelerants
- Must be repeatable a min of 5x
- Customer prefers a tubular design
- Max dim 36” L x 4.5”W x 4.5”H square or 42” L x 5.5” OD
- Functional on various surface conditions



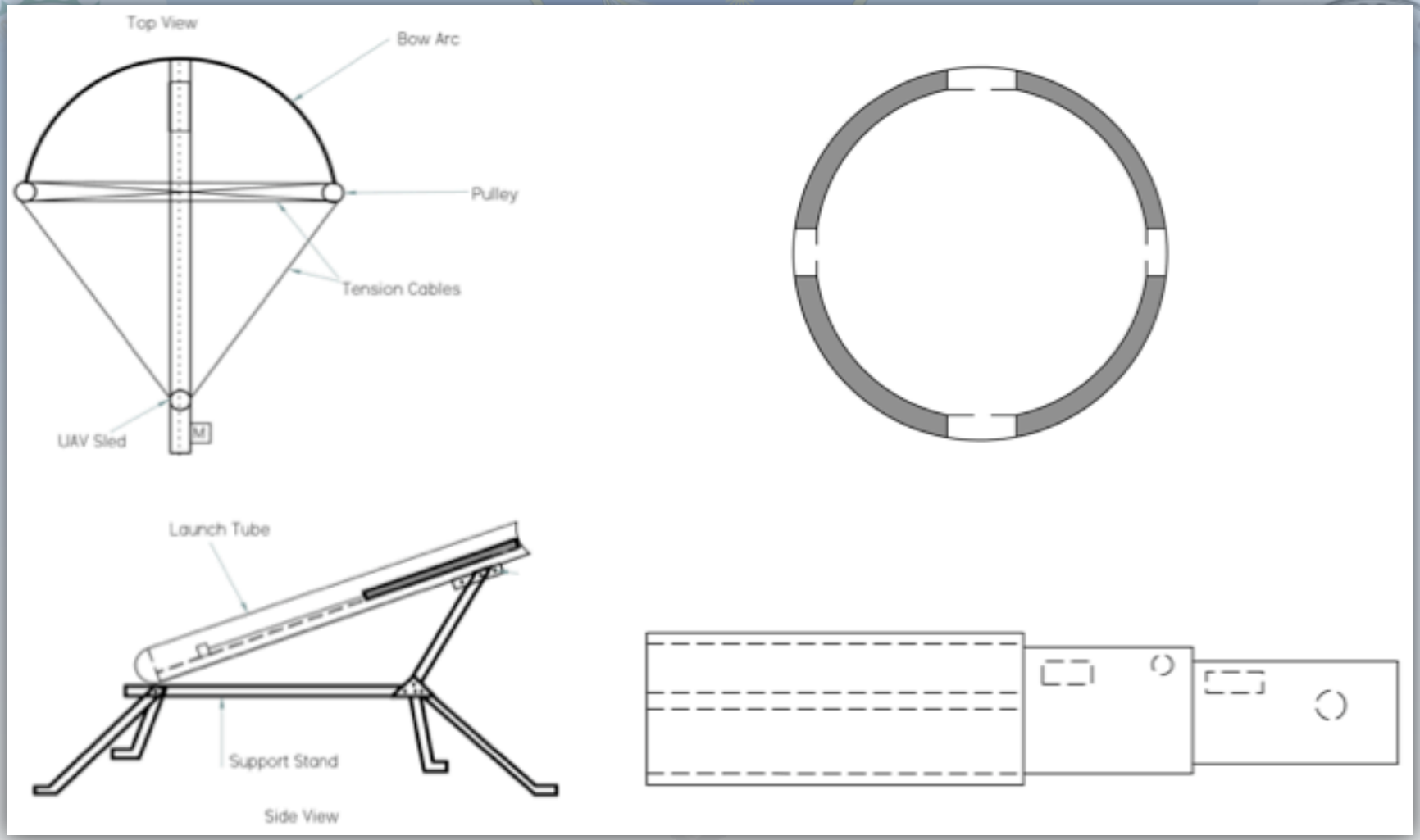
UAV

- Approx 3.5lb fully equipped
- Estimated 18” L x 4” W x 2.5” H in launch position

Concept Screening

	Concepts					
Selection Criteria	Pneumatic	Spring	Electro-magnet	Compound Pulley	Linear Actuator	Manual Launch (Reference)
Repeatable for min. 5 launches	+	+	+	+	+	0
Ease of field assembly	+	0	-	0	+	0
Ease of use	+	0	+	0	+	0
Safety	-	-	-	-	-	0
Maintenance	-	-	-	-	-	0
Durability	+	+	-	+	-	0
Reliability	+	+	+	+	+	0
Feasibility	+	+	-	+	-	0
Sum +'s	6	4	3	4	4	0
Sum -'s	2	2	5	2	4	0
Sum 0's	0	2	0	2	0	8
Net Score	4	2	-2	2	0	0
Rank	1	3	6	2	5	4
Continue?	Yes	Revise	No	Yes	No	No

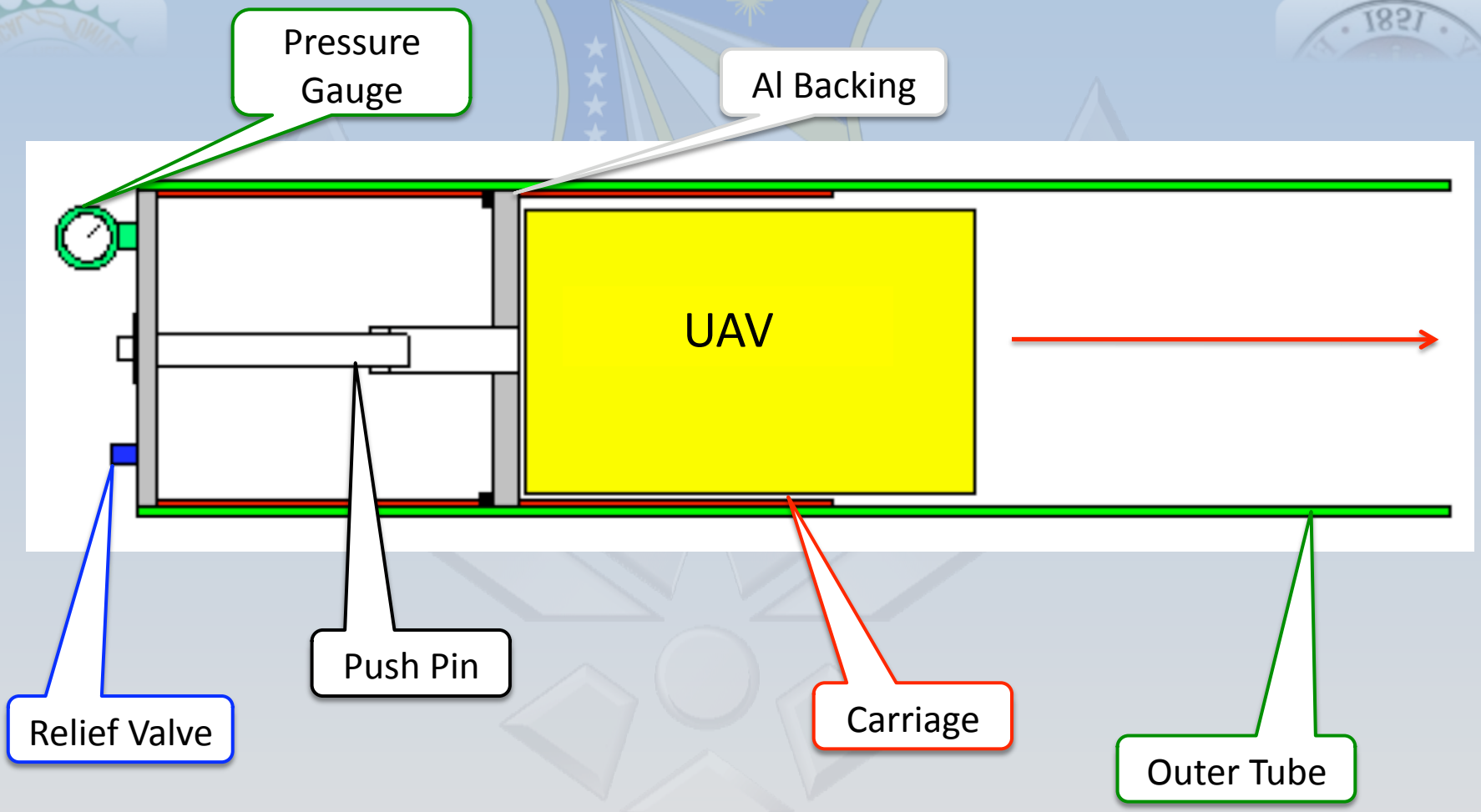
Compound Pulley & Pneumatic



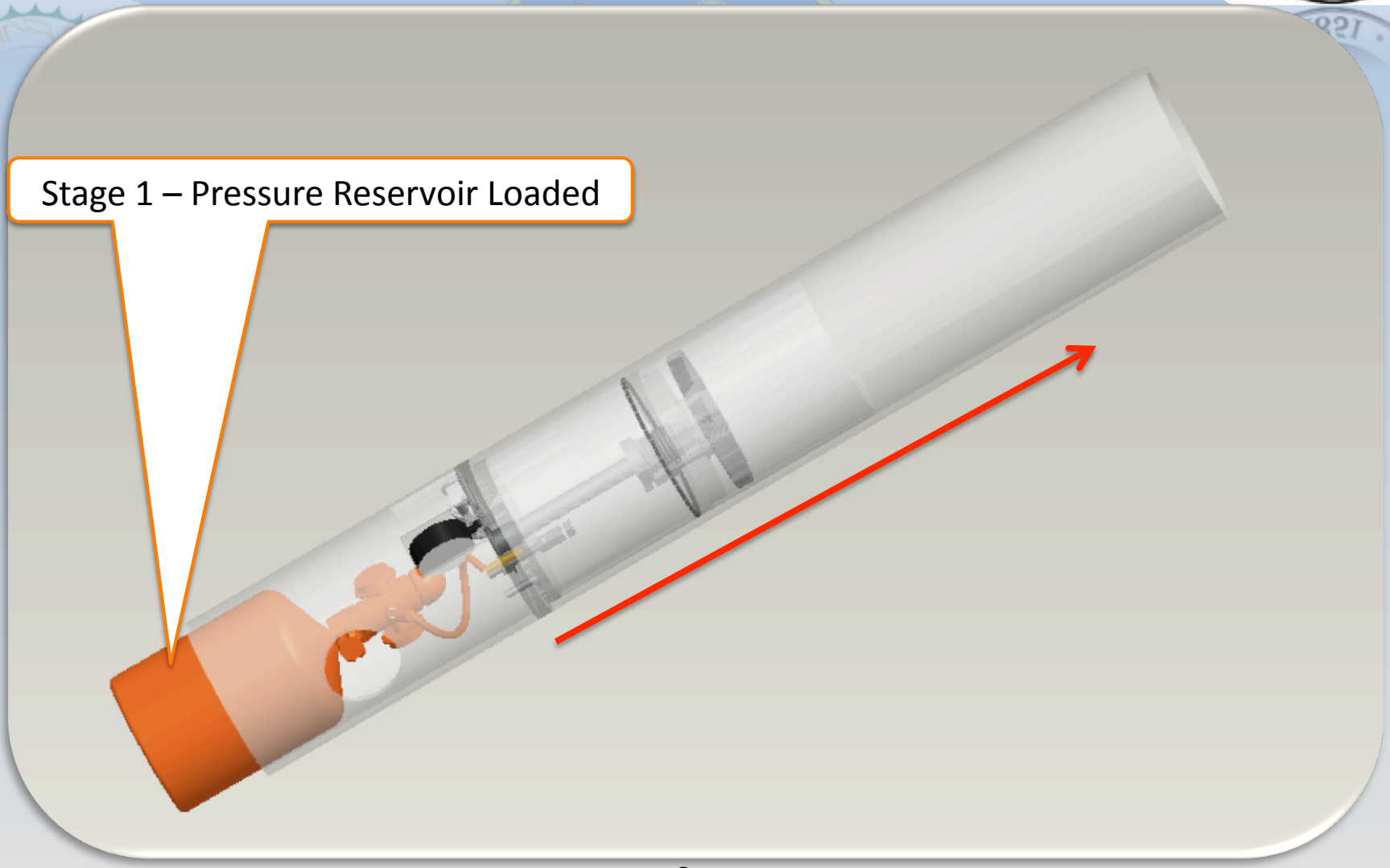
Concept Scoring

Criteria	Weighting	Concepts: Pneumatic	Spring+	Compound Pulley
Min. exit velocity of 60 ft/s	10	10	8	8
Max. Weight of 2.5 lbs	9	7	2	5
600g max. inst. Acceleration	10	9	7	7
repeatable for min. 5 launches	8	6	8	8
Cost	7	5	7	6
Ease of field assembly	7	5	3	4
Ease of use	7	5	3	4
Safety	10	3	4	4
Maintenance	7	5	7	6
Durability	8	4	6	5
Reliability	9	8	8	7
Feasibility	8	7	4	5
Total	100	74	67	69
Weighted Total		74%	67%	69%

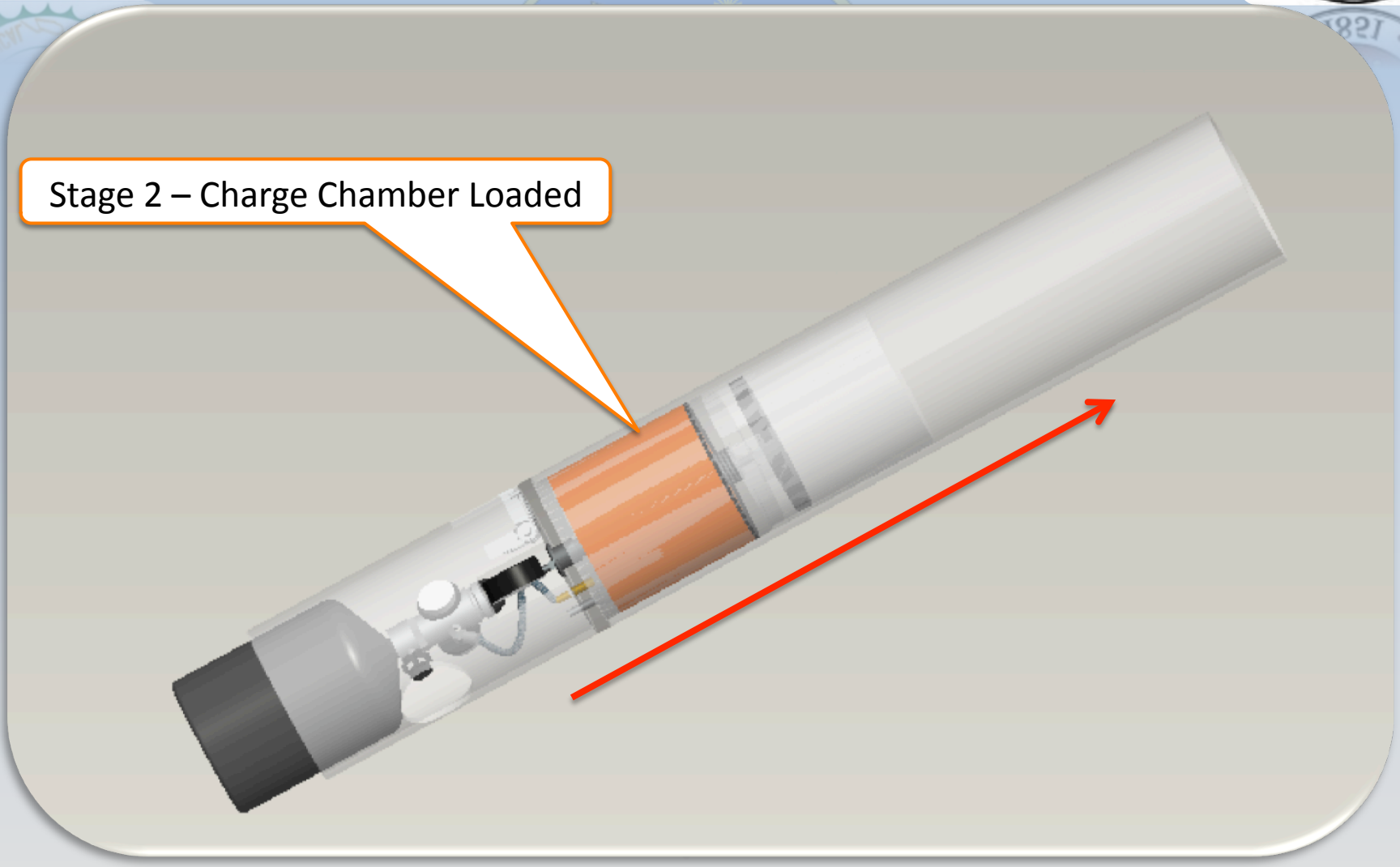
Pneumatic Concept



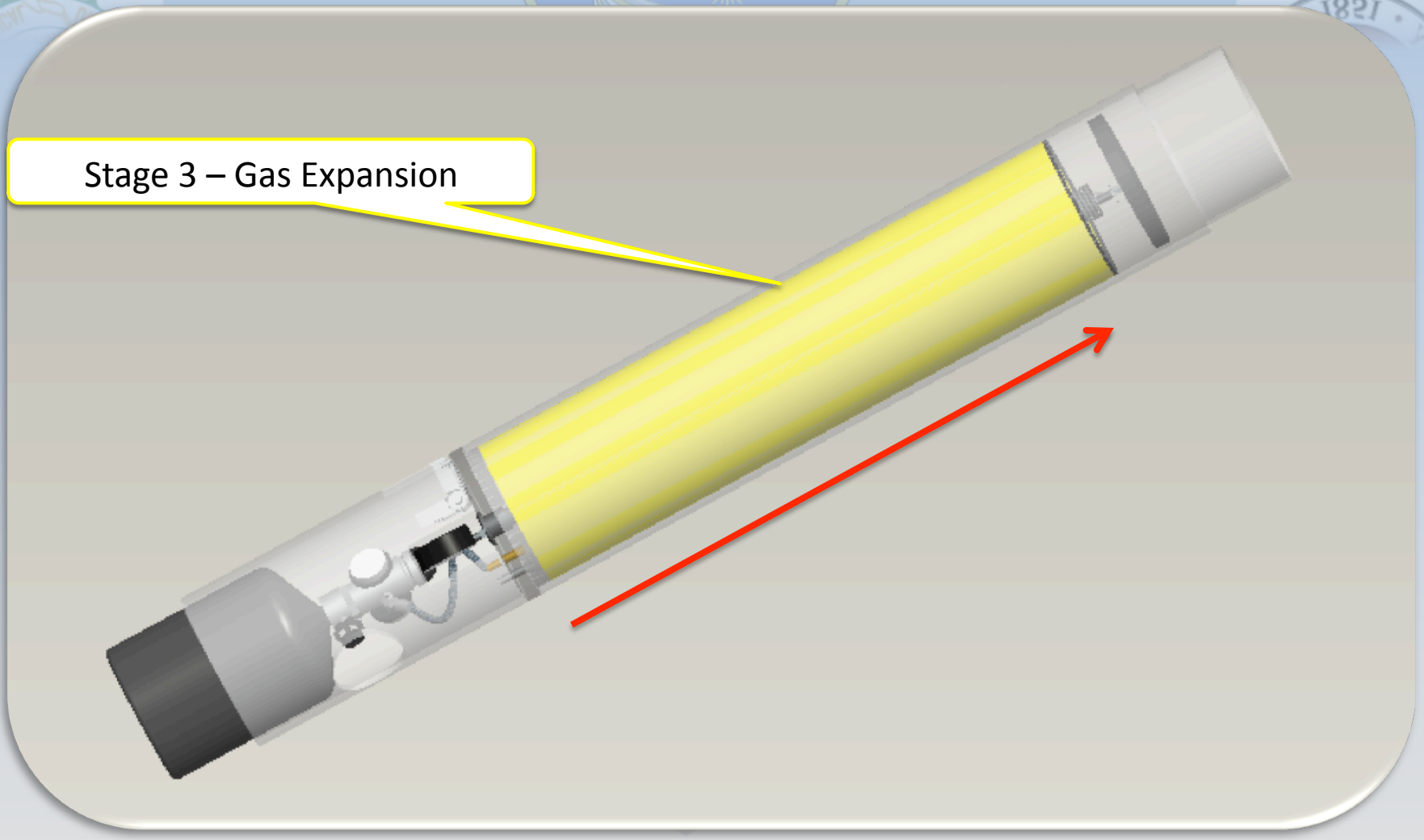
Design Functionality



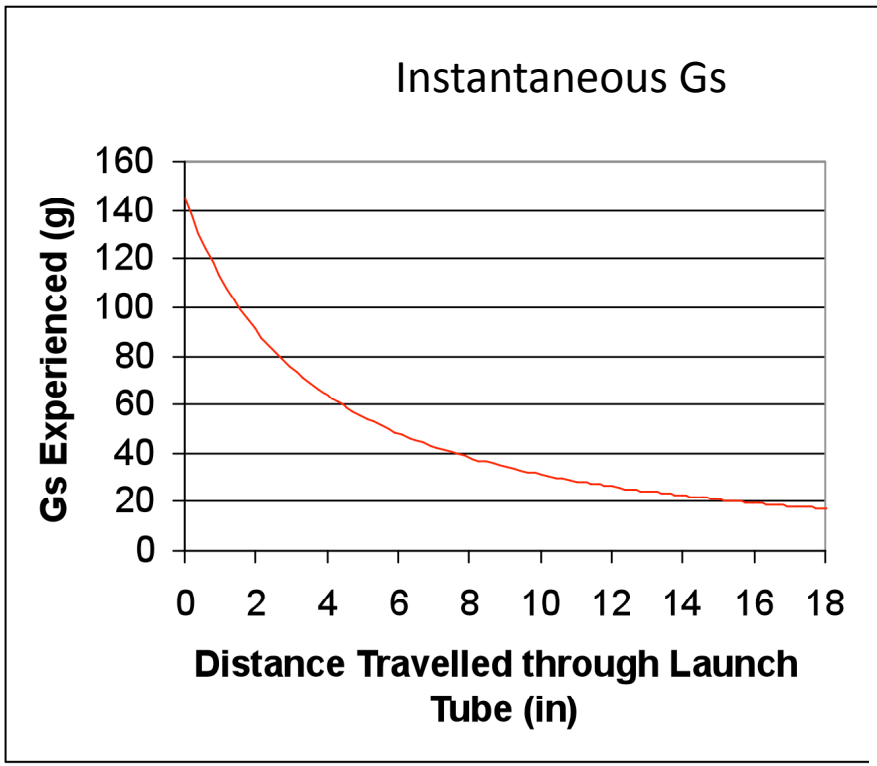
Design Functionality

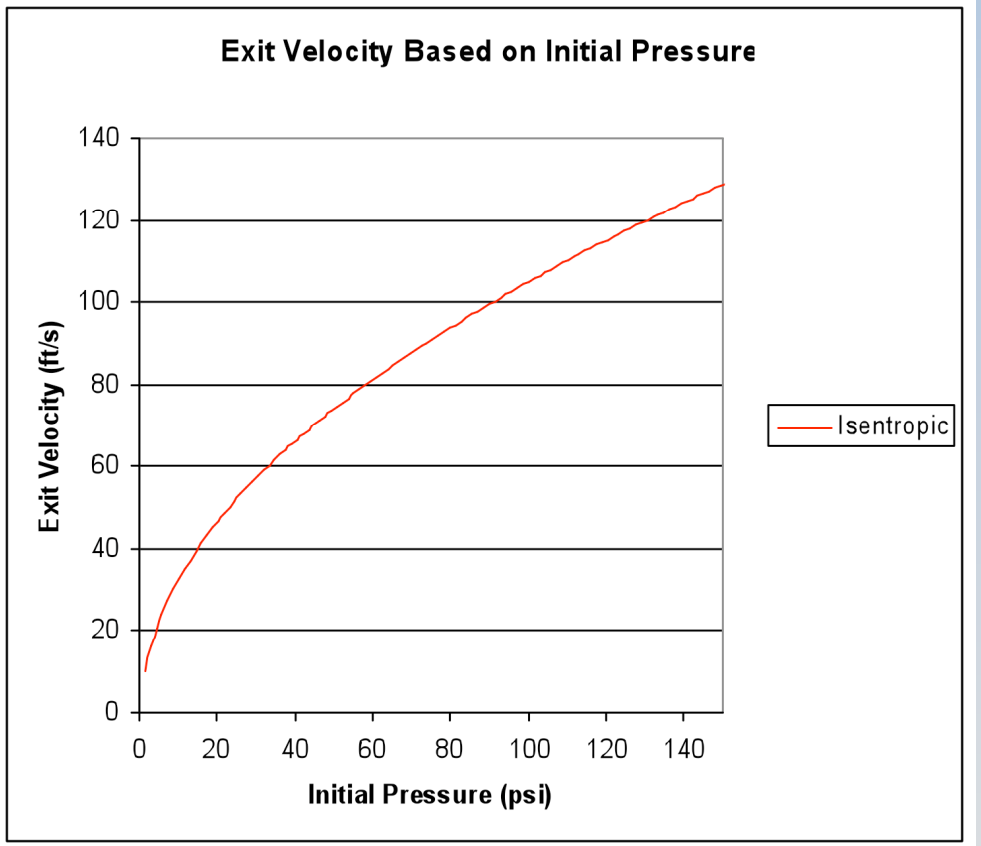


Design Functionality



Theoretical Analysis



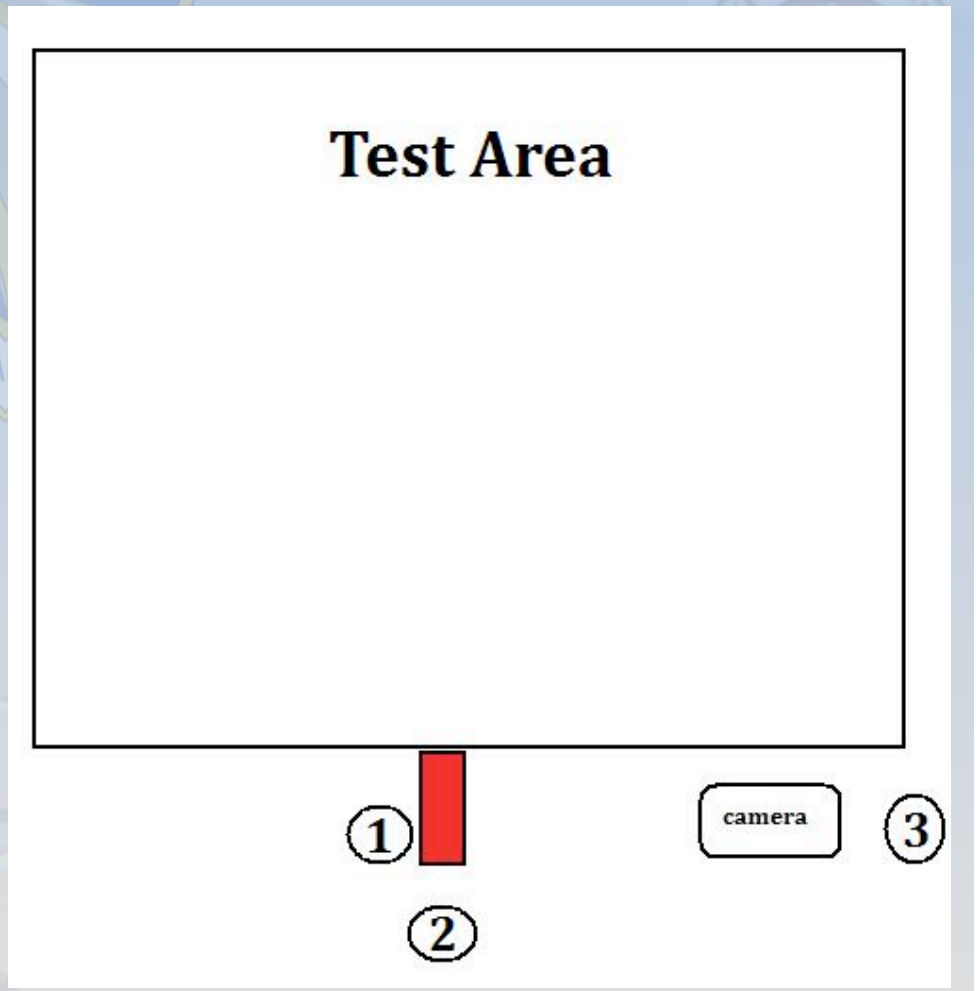


Isentropic PV^{γ}

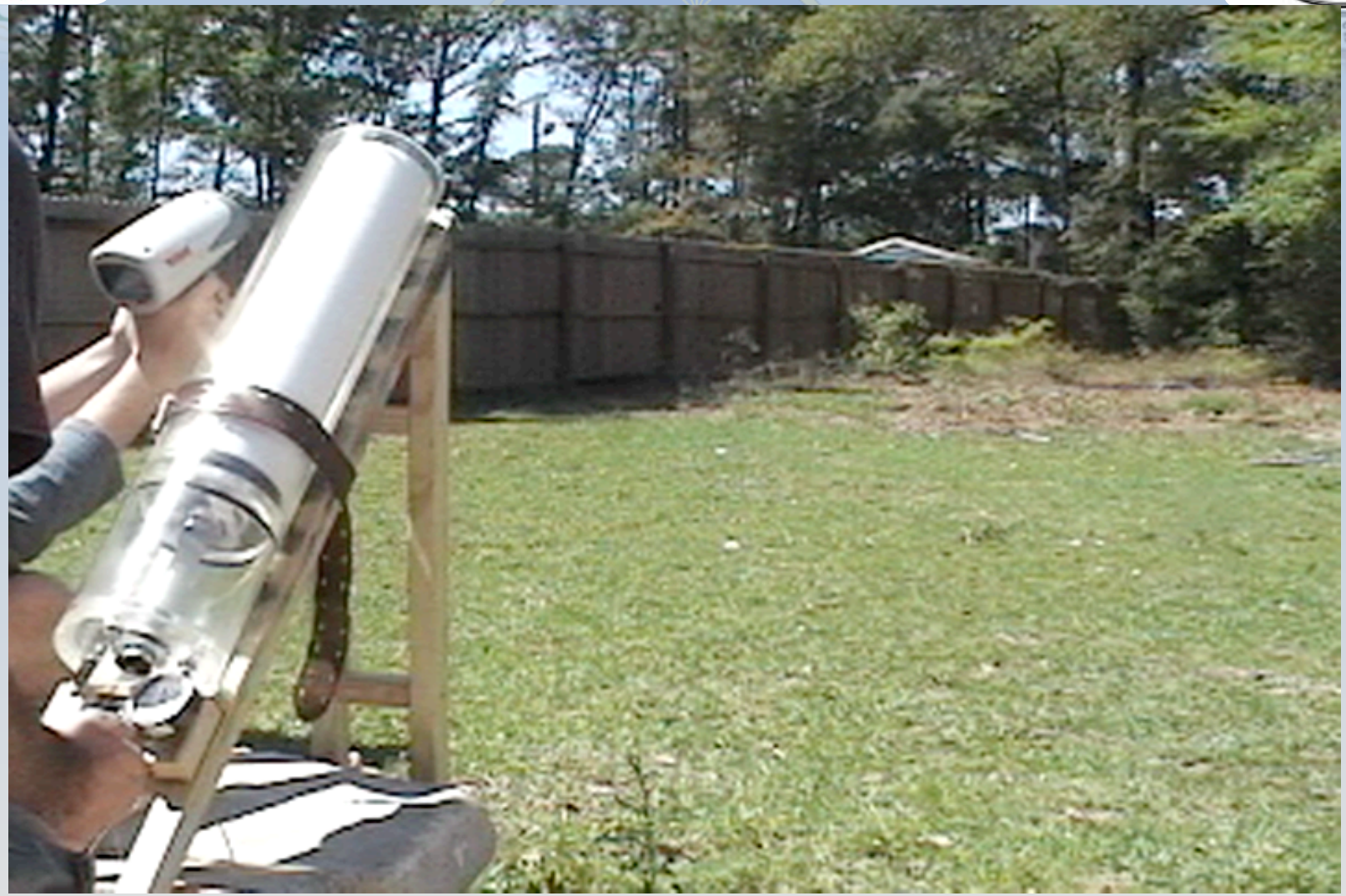
Polytrophic $PV^{?}$

Testing Prototype

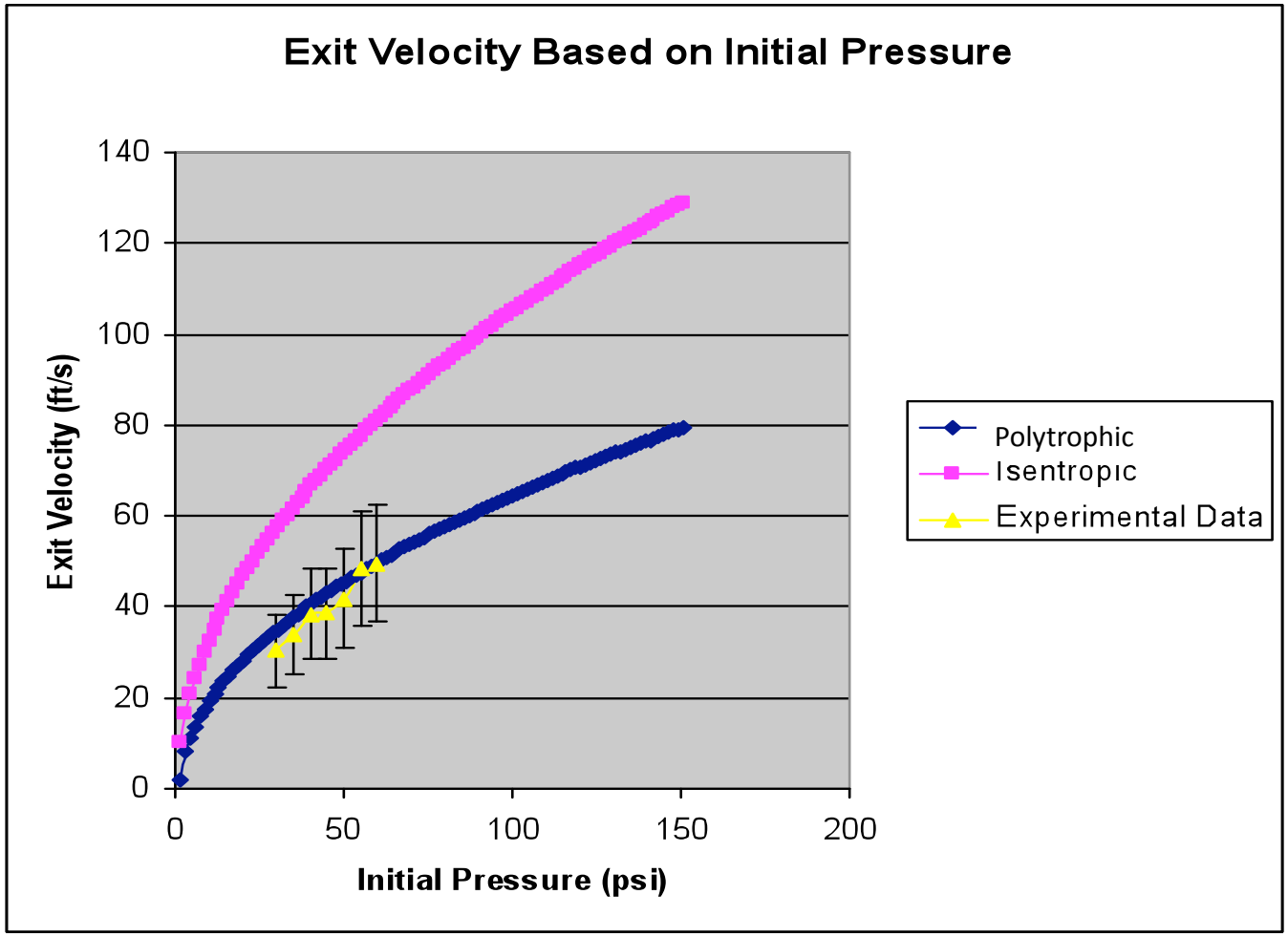
Testing Procedure



Testing Procedure

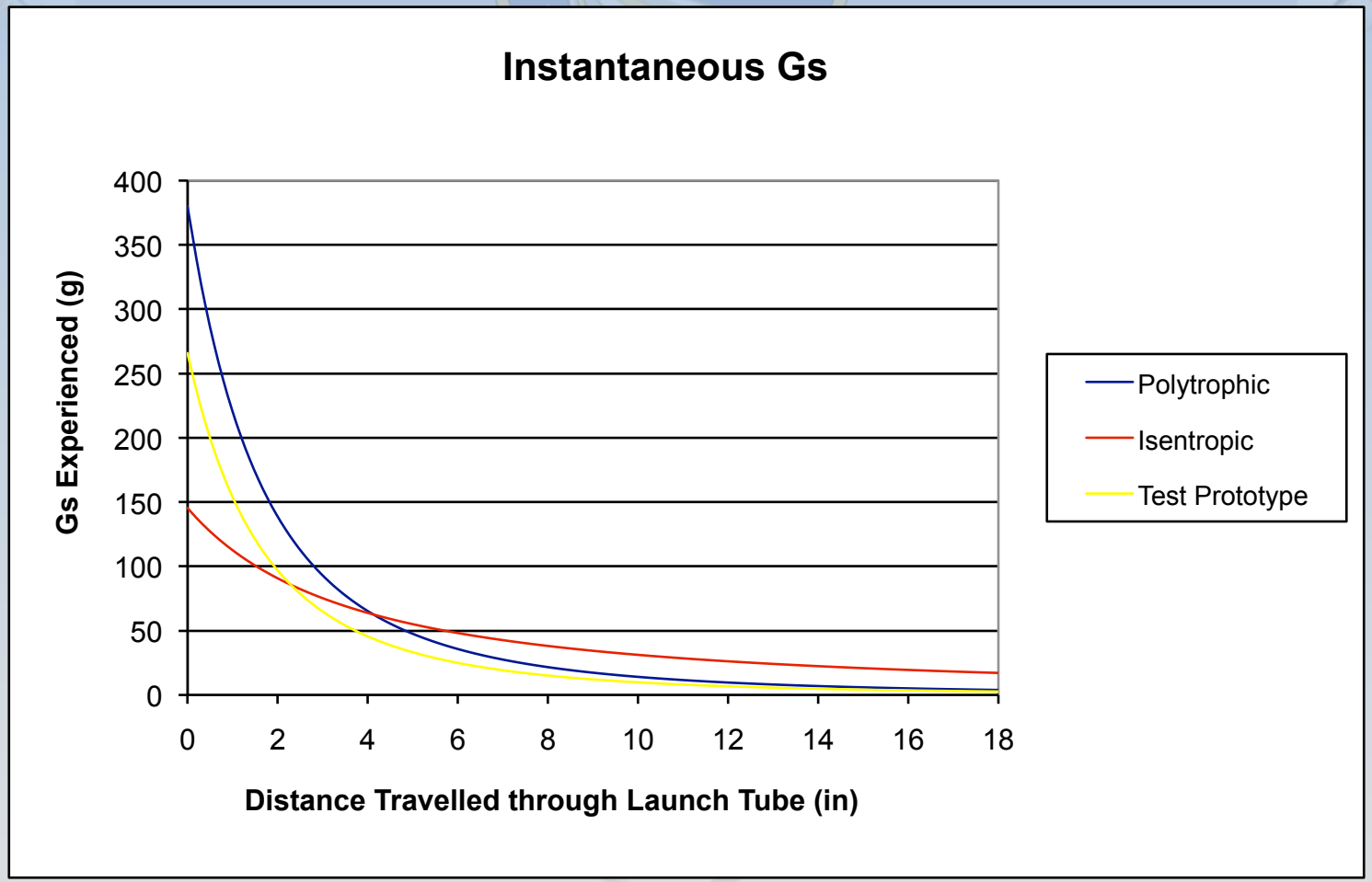


Testing Results

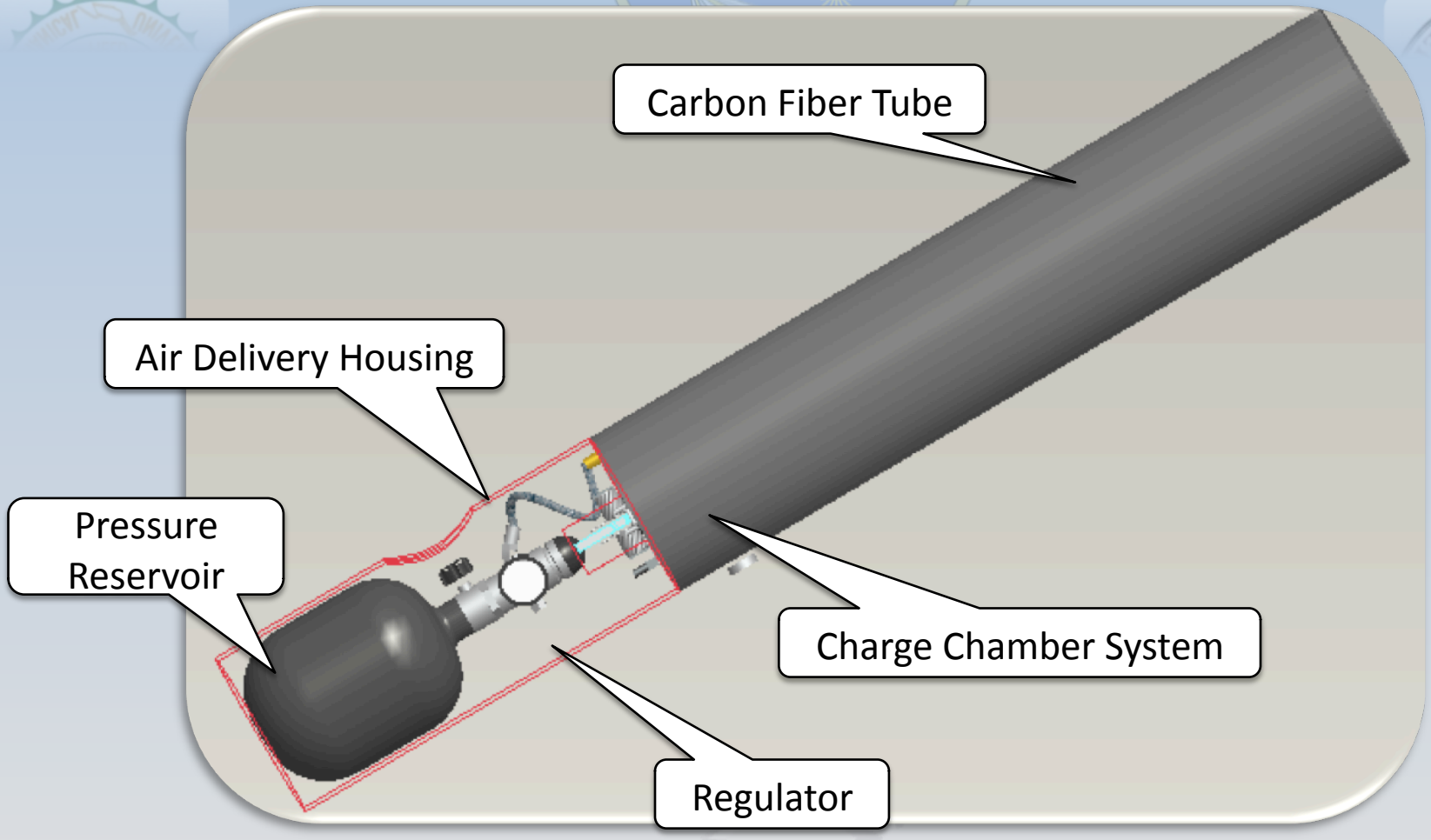


Isentropic PV^{γ} Polytrophic PV^{n}

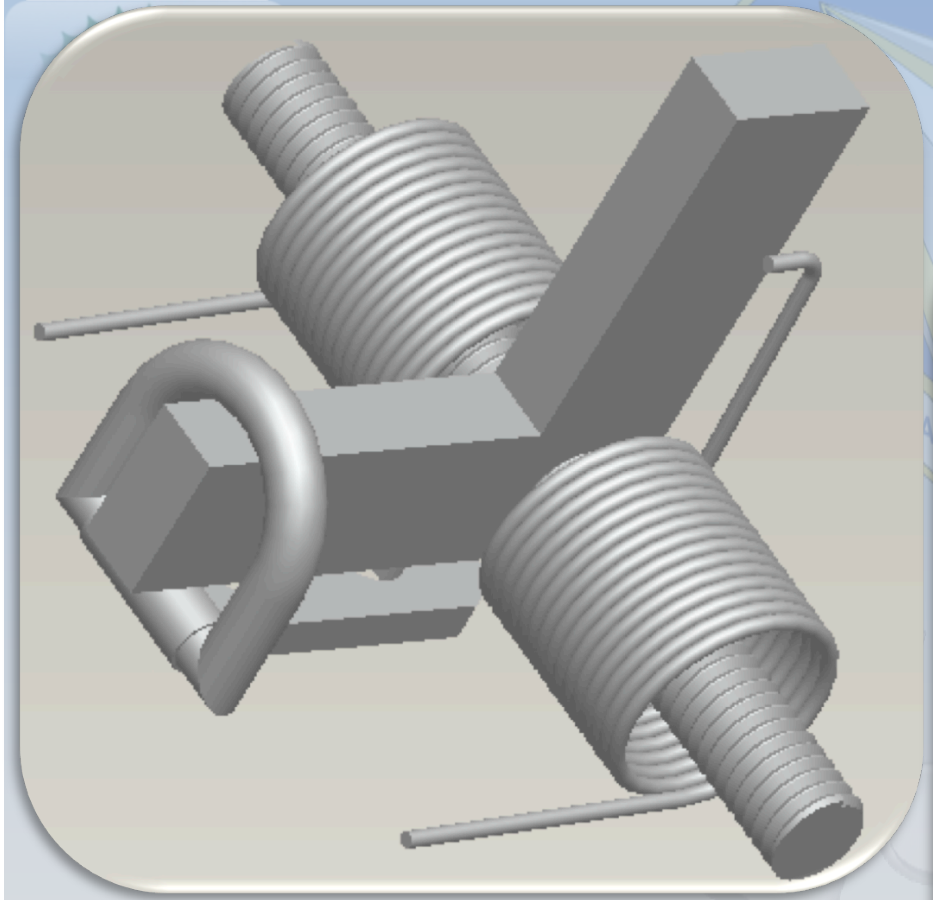
Instantaneous Acceleration

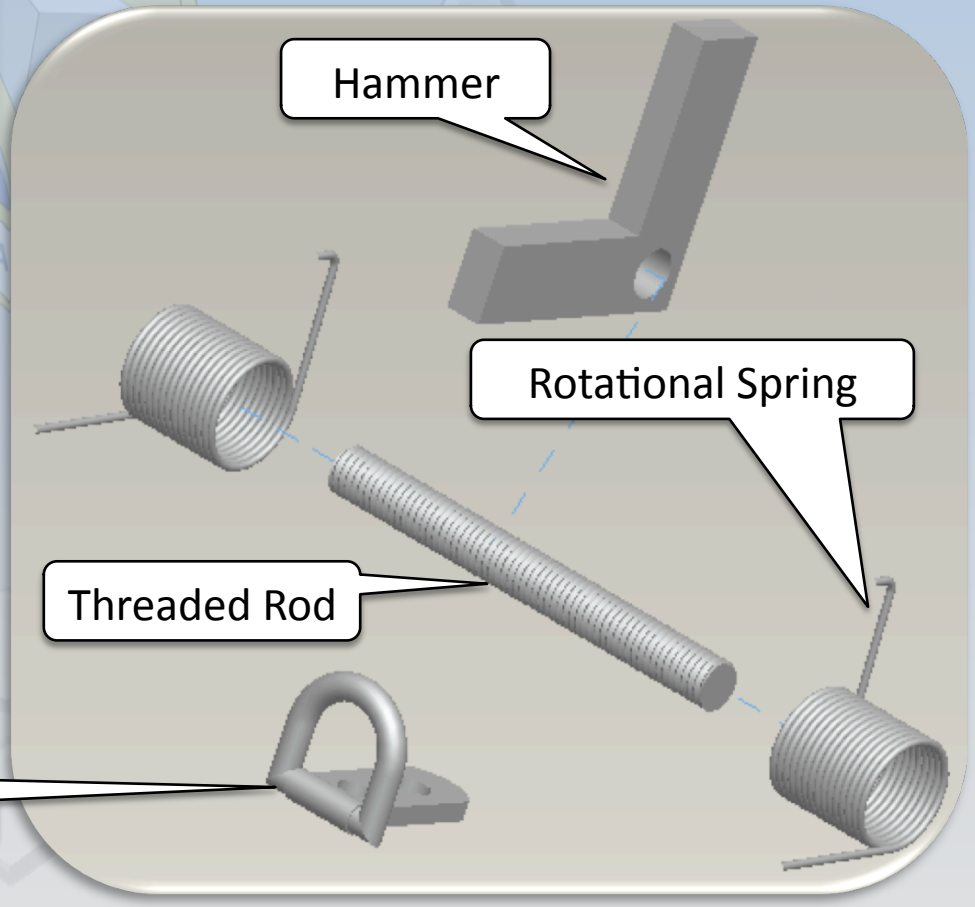


Final Design

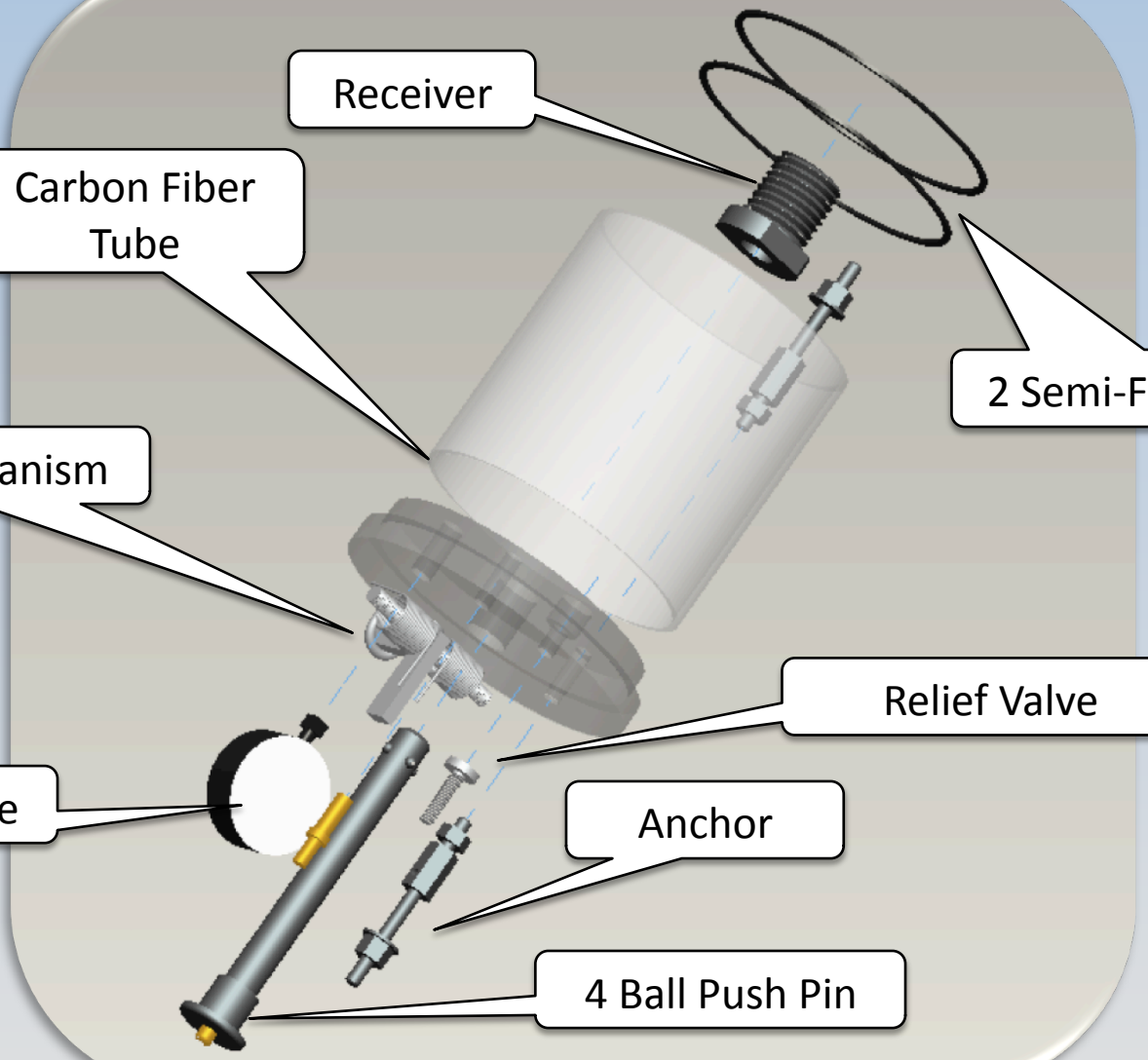


Trigger Mechanism



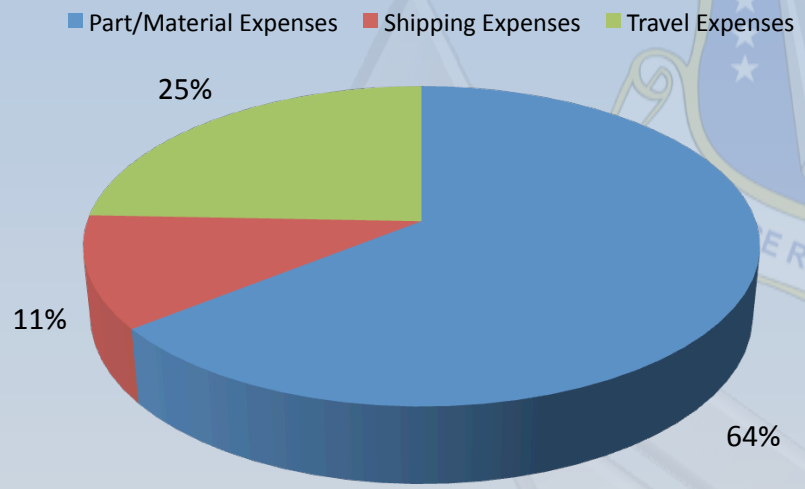


Charge Chamber



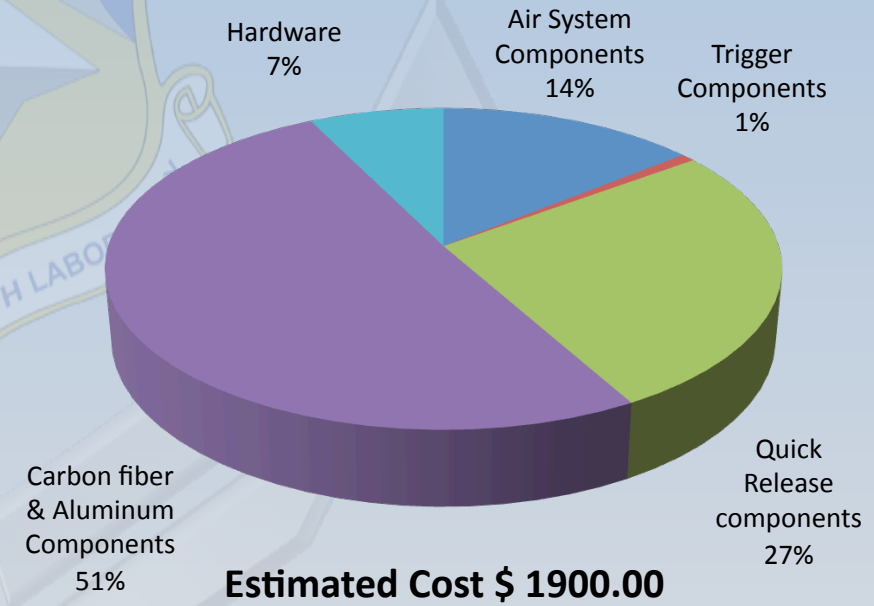
Success…

Prototype Expense Distribution



Final Cost $ 1105.36

Final Design Parts & Material



Estimated Cost $ 1900.00

- ✓ 60ft/sec Exit Velocity
- ✓ Less than 600Gs Acc
- ✓ Less than 11lb
- ✓ Safe
- ✓ 42”x 5.5”

Methods of Improvement

Design Improvements

- Develop a more efficient means of activating the quick release button.
- Develop a launch stand with dampeners to reduce recoil.

Testing Improvements

- Test velocity using more accurate devices.
- Purchase accelerometers capable of withstanding 600gs.
- Cleaner testing environment.

Recognition

Sponsor – Eglin AFB

- John Deep
- Jeff Wagener

Technical Support

- Dr. Alvi – Calculations
- Keith Larson –Machine Shop
- Coral Reef Scuba Dive Shop

THANKS TO ALL