Compact Pneumatic UAV Launcher

FAMU - FSU College of Engineering

Sponsored By Eglin Air Force Base

Launch Team - Group 3

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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.

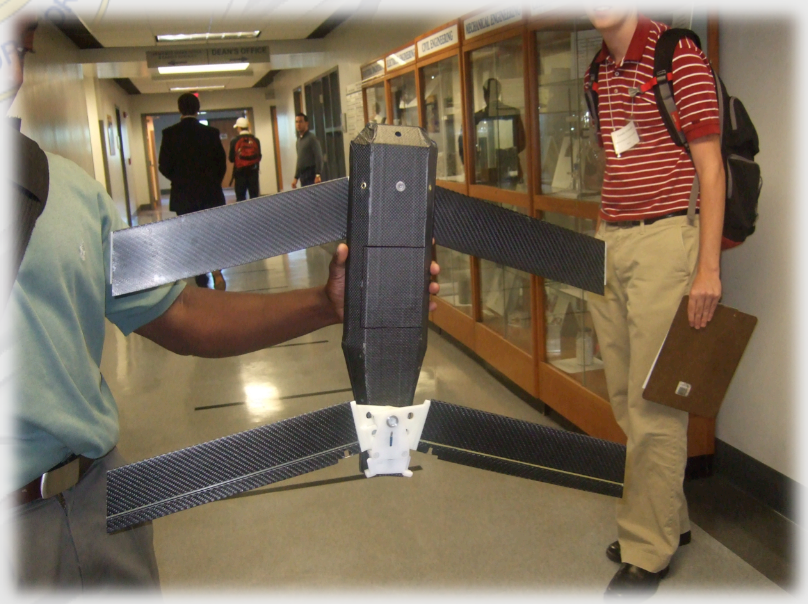
Background

- 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 Instantaneous acc
- Launcher weight limit: 2.5 lbs, including stand etc.
- 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 36" x 5.5" diameter



UAV

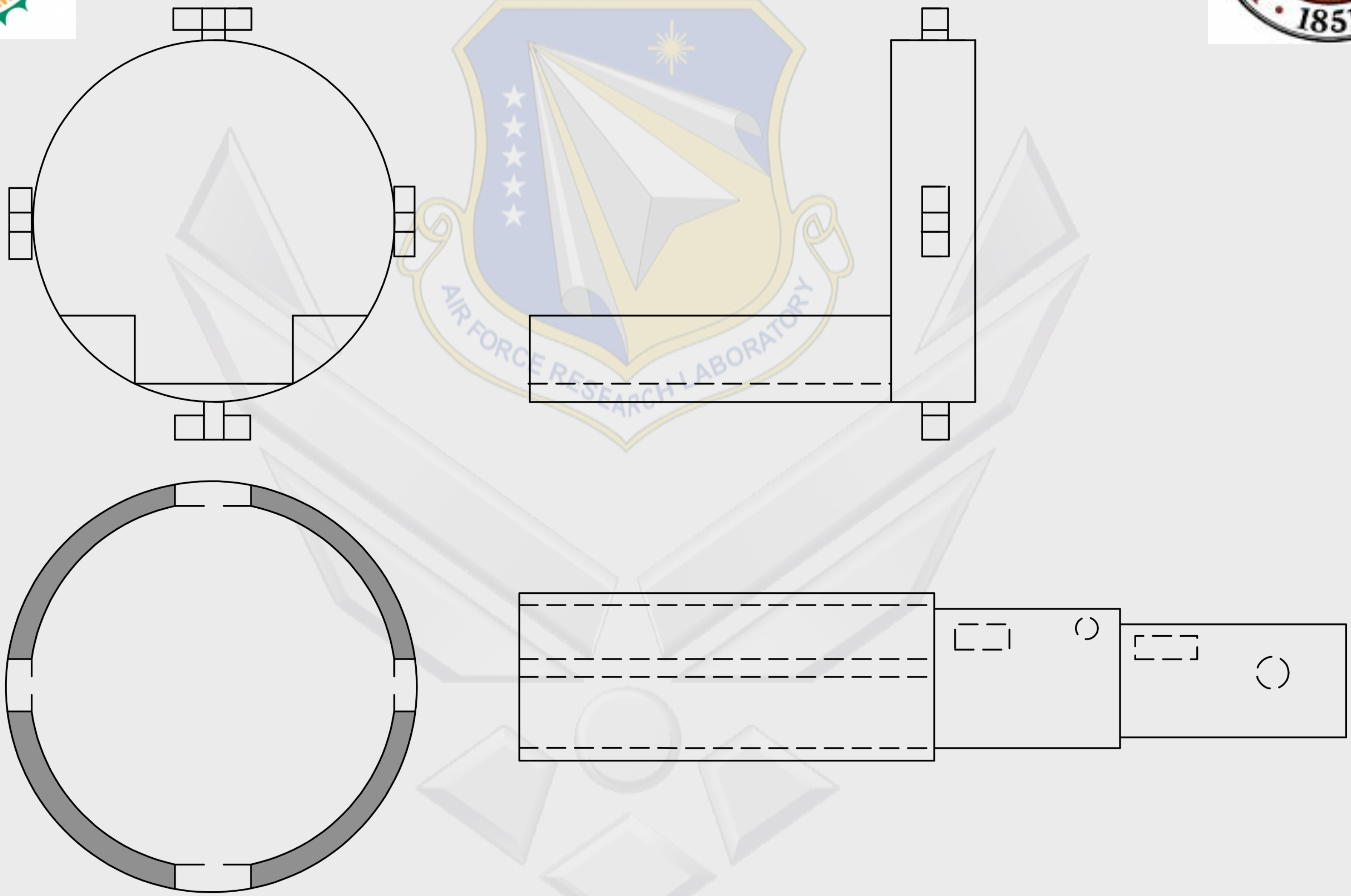
- Approx 3.5lb
- Approx 18" L x 4" W x 2.5" H collapsed

Progress to Date

- Necessary research
- Proper theoretical mathematical analysis
- Completed a feasible conceptual design
- Altered the conceptual design to a more efficient, feasible, effective, & safe interim design
- Visited sponsor to assess real-time use
- Derived a feasible prototype for testing



Conceptual Design



Launch Team - Group 3

Thursday 11-06-2008

Recent Design Changes

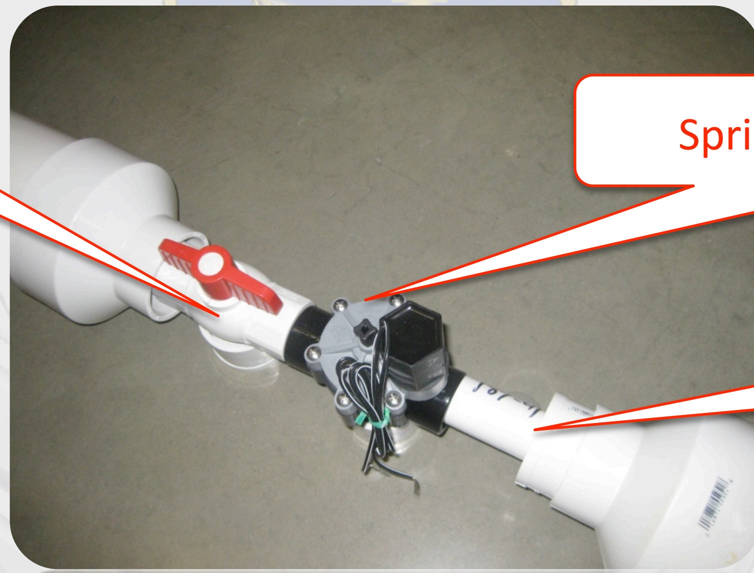
- Valve release instead of a pin release

- Discontinued the telescopic tube due to cost & complexity

- Sponsor confirmed that a simple foam or rubber back plate would be most effective

- Flow regulator btwn reservoir & compression chamber

Current Prototype



Experimental Plan

Purpose

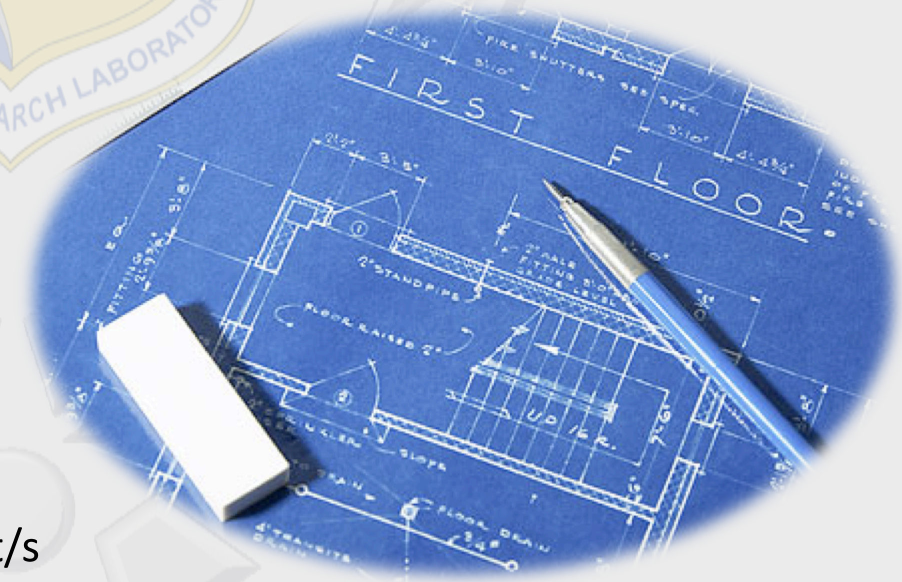
To better understand the processes and theories associated with launching a non-uniform projectile from a tube & to collect actual data to manipulate launcher performance.

Components

- Using the prototype PVC launcher
- 50yrd open field

Data Collection

- Methods to reduce "blow-by"
- The effects of barrel length
- Effects of recoil
- Assuring minimum exit velocity of 60ft/s
- Assuring not to exceed maximum acceleration of 600Gs
- How the pressure increases or decreases over the distance of the launch tube

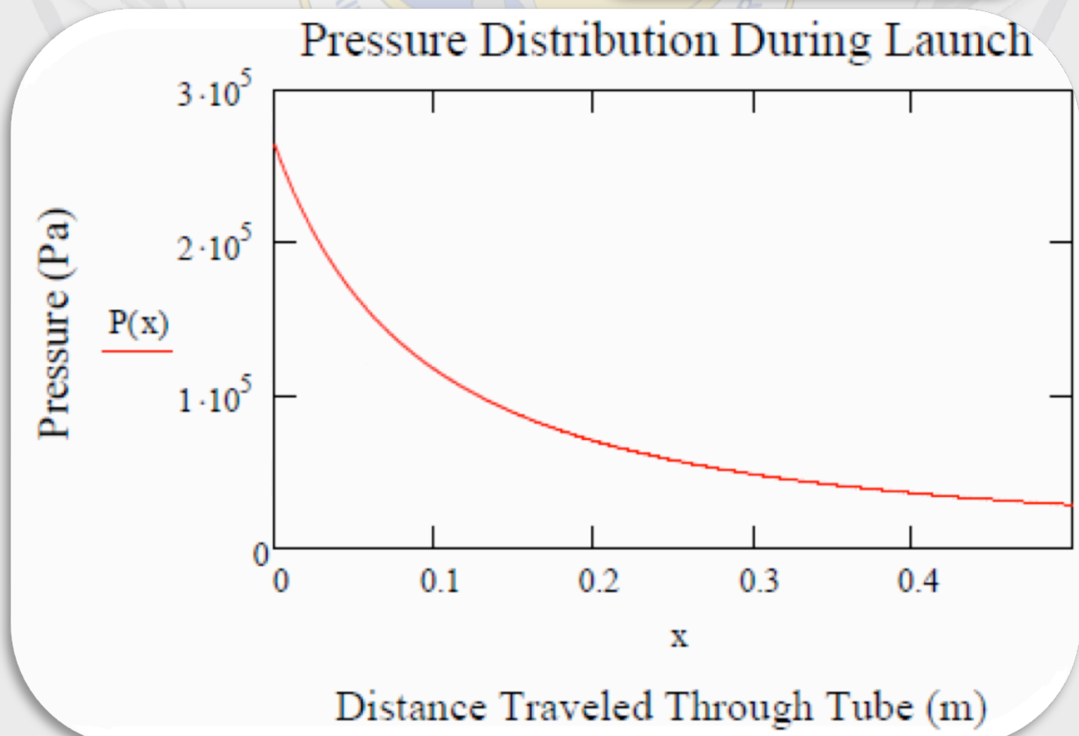


Mathematical Analysis

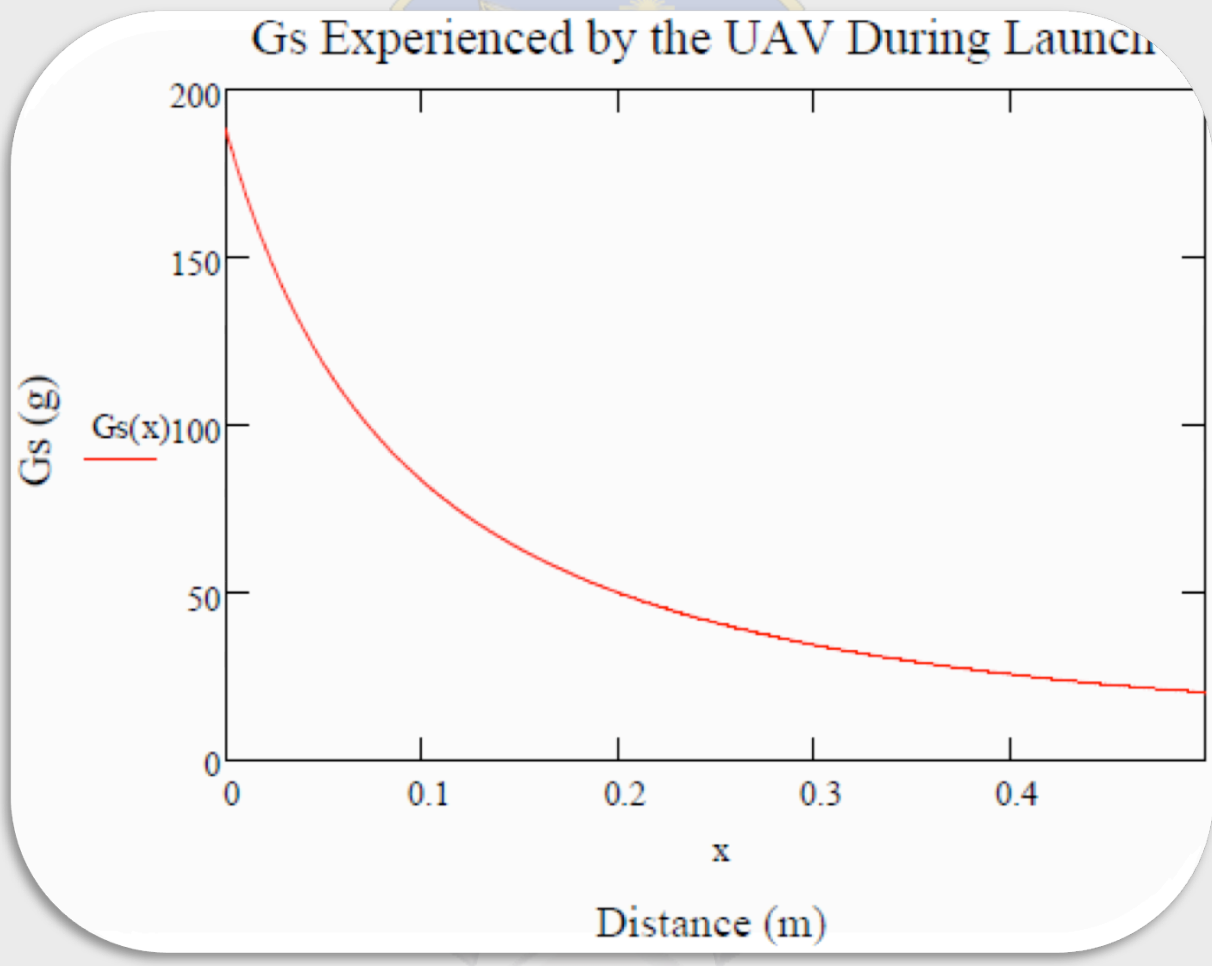
Assuming adiabatic, polytropic process

$$P \cdot V^{\gamma} = \text{Constant}$$

$$P(x) := P_0 \cdot \left(\frac{x_0}{x + x_0} \right)^{\gamma}$$



Mathematical Analysis



Gs(0m)=188.01

Mathematical Analysis

Pressure inside Vessel

$$P \cdot V = m \cdot R \cdot T$$

$$m_{Charge} := \frac{P_{Charge} \cdot Volume_{Charge}}{R_{air} \cdot T_{AIR}}$$

$$P_{ResevoirTotal} := \frac{m_{ResevoirTotal} \cdot R_{air} \cdot T_{AIR}}{Volume_{Tank}}$$

$$P_{ResevoirTotal} = 311.88\ psi$$

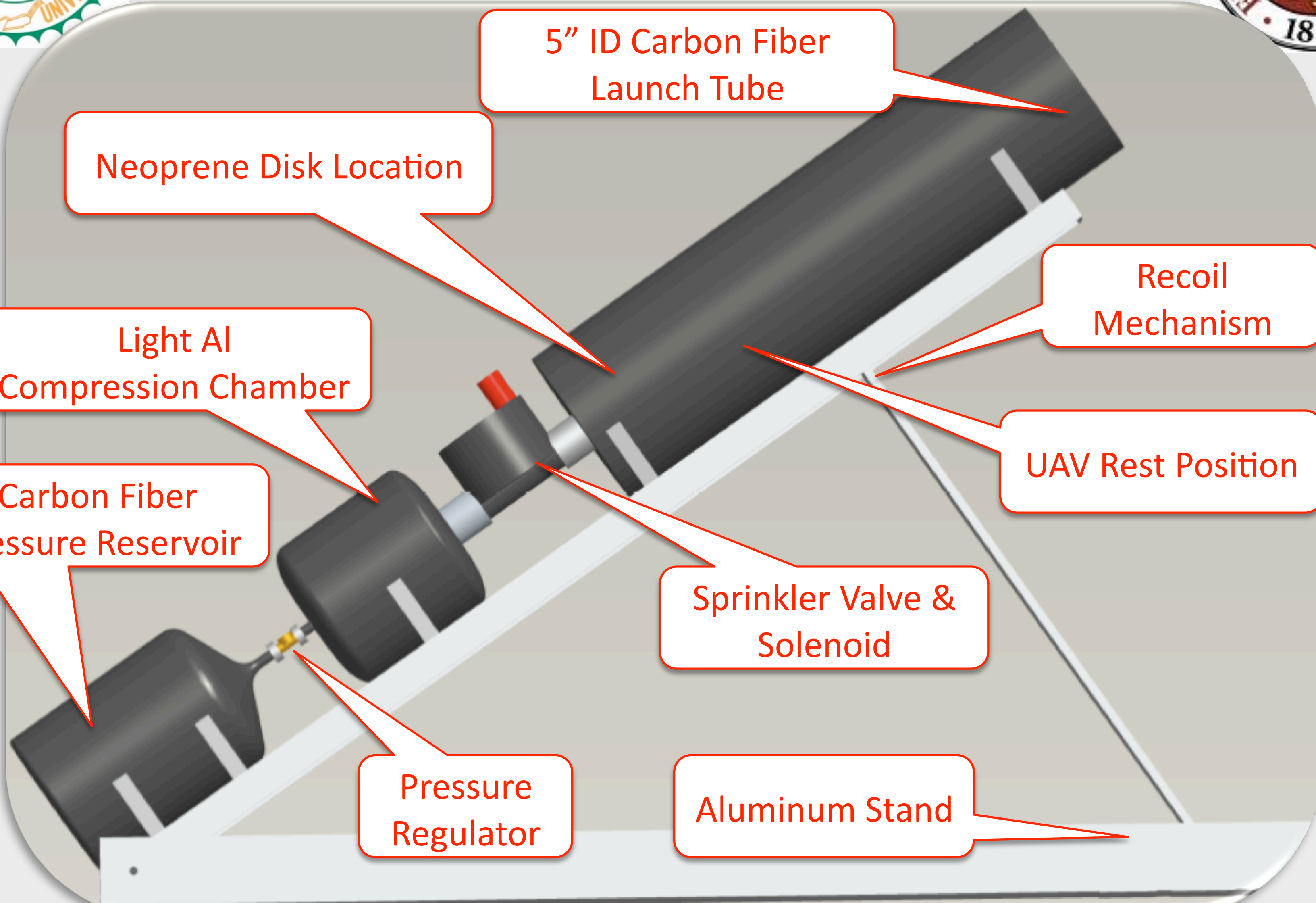
Charge Chamber Stress Calculations

$$\sigma_{1HoopStress} = \frac{P \cdot r}{t}$$

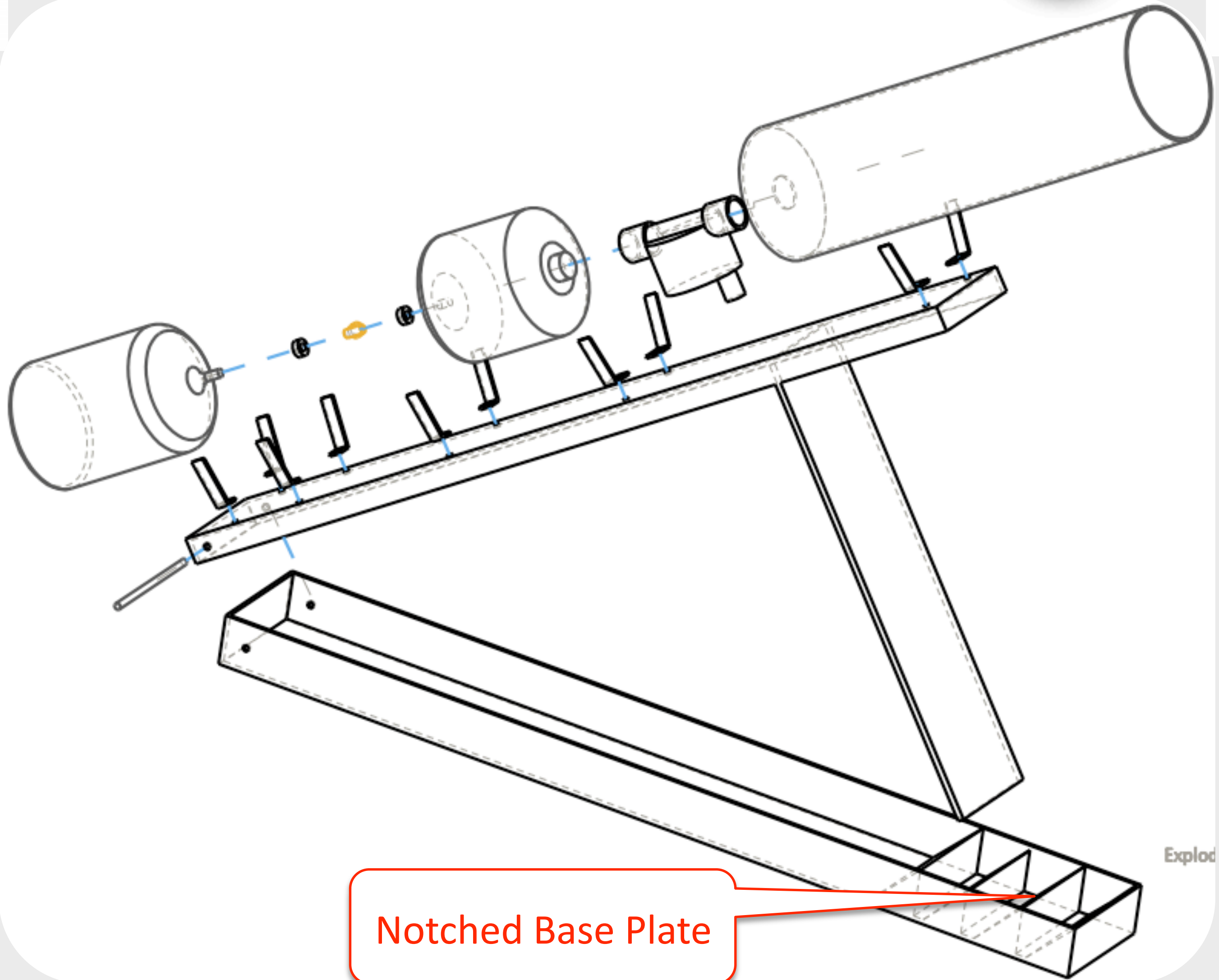
$$\sigma_{Charge} = 383.011\ psi$$

$$F_S := \frac{\sigma_y}{\sigma_{Charge}} \qquad F_S = 81.416$$

Current Aspiration



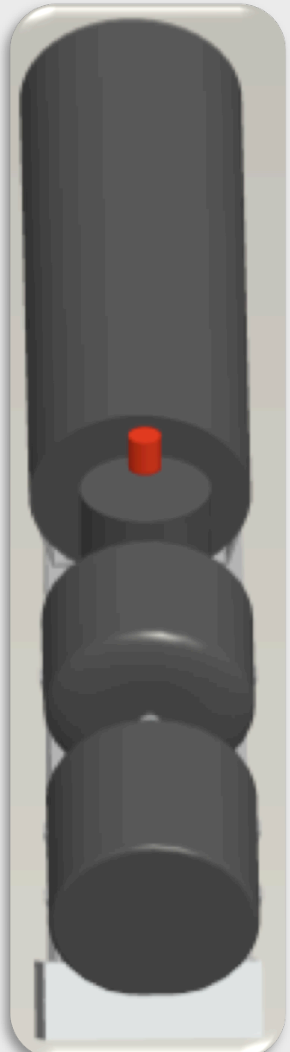
Current Aspiration

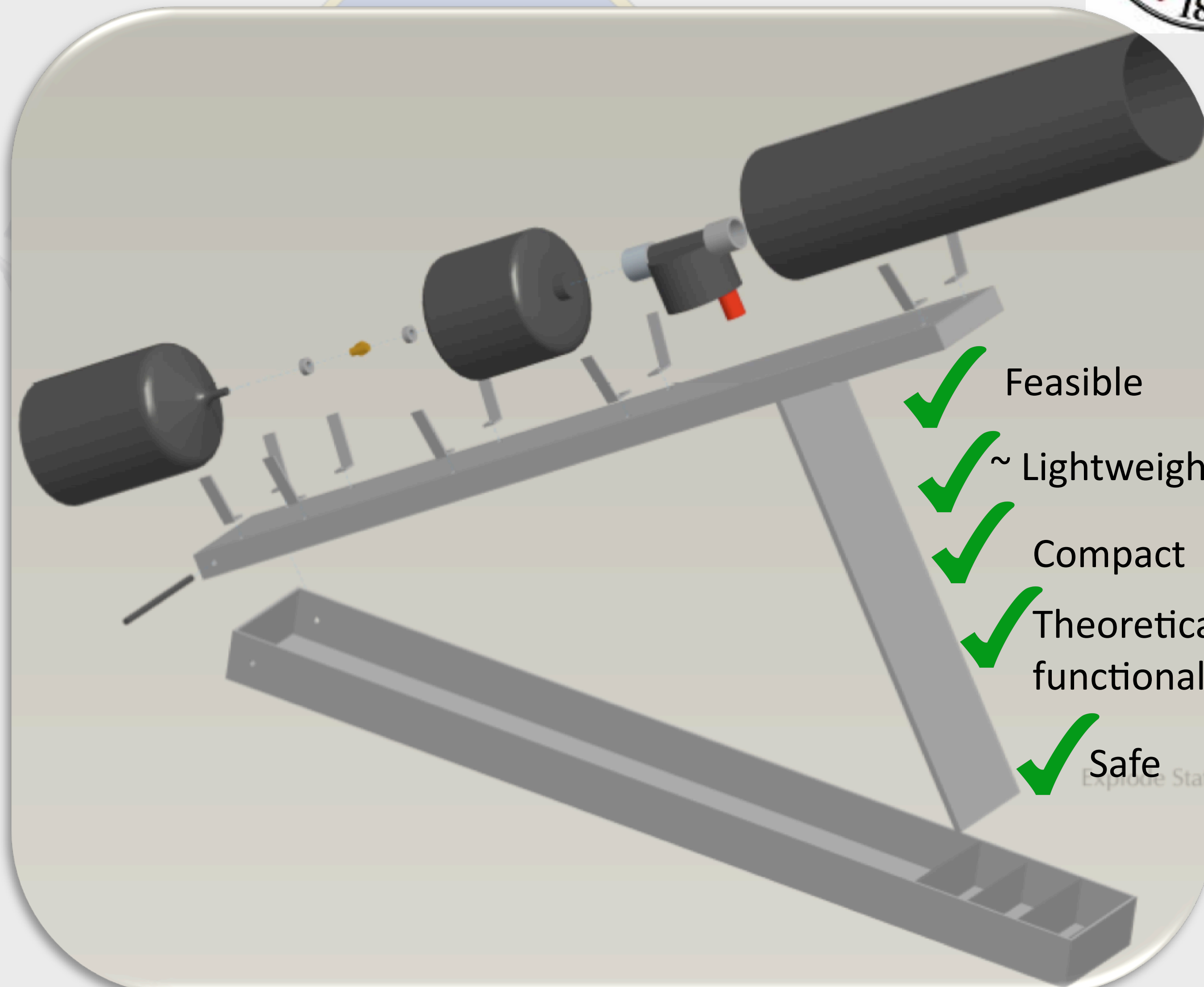


Financial Aspect

Prototype Component	Qty	Price	Vendor	Final Design Component	Qty	Price	Vendor
PVC Cleaner	1	4.94	Lowes				
PVC Primer	1	2.52	Lowes	Carbon Fiber Reservoir	1	154.95	Guerrilla Air
Clear Cement	1	3.48	Lowes	In-Line Pressure Regulator	1	39.95	Lowes
Gas Tape	1	2.63	Lowes	Gas Tape	1	2.63	Lowes
5"x3' Acrylic PVC Pipe Sch 40	1	109.36	MMC	4"x2' PVC Pipe Sch 40	1	4.97	Lowes
4"x2" PVC Coupling	1	4.93	Lowes	Steel Braided Line	1	19.90	Lowes
1" PVC Ball Valve	1	5.17	Lowes	1" PVC Ball Valve	1	5.17	Lowes
2"x2' PVC Pipe Sch 40	1	2.53	Lowes	Aluminum Stand Fabrication	1	200.00	Eglin AFB
2"x1' Sch 20 Bushing	1	1.76	Lowes	Carbon Fiber Fabrication	1	375.00	Eglin AFB
5" PVC Cap	2	5.44	Lowes	4" PVC Cap	2	5.44	Lowes
1" Rainbird Valve	1	15.78	Lowes	Rainbird Valve	1	15.78	Lowes
5" Neoprene Backing Disk	1	30.00	MMC	Neoprene Backing Disk	1	-	MMC
5" Foam Backing Disk	1pk	15.00	MMC	Foam Backing Disk	1pk	-	MMC
Total with 7.5% Tax		**224.65**		**Total with 7.5% Tax**		**891.4**	
				Total with Eglin Supplement		**267.5**	

Conclusion





- ✓ Feasible
- ✓ ~ Lightweight
- ✓ Compact
- ✓ Theoretically functional
- ✓ Safe

Status Report

ID	Duration	Task Name	Start	Finish
15	**21 days**	**Detailed Design**	**Thu 10/16/08**	**Thu 11/6/08**
16	16 days	Mathmatical Calculations	Thu 10/16/08	Sat 11/1/08
17	11 days	Detailed Drawings	Sun 10/26/08	Thu 11/6/08
18	4 days	Final Detailed Design Review	Sat 11/1/08	Wed 11/5/08
19	**7 days?**	**Fall Report**	**Thu 11/6/08**	**Thu 11/13/08**
20	1 day	Updating/Compiling Information	Thu 11/6/08	Fri 11/7/08
21	2 days	Revise Midterm Report	Fri 11/7/08	Sun 11/9/08
22	1 day?	Compile Final Report	Sun 11/9/08	Mon 11/10/08
23	2 days	Powerpoint Preparation	Mon 11/10/08	Wed 11/12/08
24	1 day	Webpage Update	Wed 11/12/08	Thu 11/13/08
25	7 days	Purchase Materials	Wed 1/7/09	Wed 1/14/09
26	17 days	Prototype Assembly	Sat 1/17/09	Tue 2/3/09
27	14 days	Testing	Tue 2/3/09	Tue 2/17/09
28	21 days	Finalize Design	Tue 2/17/09	Tue 3/10/09
29	40 days	Build Product	Sun 3/1/09	Fri 4/10/09
30	14 days	Final Report	Fri 4/3/09	Fri 4/17/09

Our Next Move…

72hr Plan:

- Await procurement & assemble prototype
- Begin final report

7 Day Plan:

- Simulate & test the design & theory using the prototype
- Consider revising or modifying components based on test data

14 Day Plan:

- Finalize the design in preparation for fabrication and further analysis

For further info see geocities.com/jrod23dhs/group3.html

Recognition

Sponsor – Eglin AFB

- John Deep
- Jeff Wagener

THANKS

Technical Support

- Dr. Alvi - Calculations
- Dr. Shih - Guidance
- Hobby Town USA - Guidance